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## JAPAN'S POTENTIAL ROLE IN A MILITARY-TECHNICAL REVOLUTION

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# **“Japan’s Potential Role in a Military-Technical Revolution”**

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## Summary

By the 1930s, Japan had achieved the objectives of its 1868 Meiji Restoration. It had created a heavy industrial system of world rank supporting a modern military establishment to defend itself against western colonialism. This singular achievement led to the one thing the strategy was intended to prevent — defeat and domination by foreigners. Industrial growth ended centuries of autarky; a modernized Japan depended on imports for its technology, energy, raw materials, and strategic industrial supplies. To ensure itself of these inputs, it embarked on its own colonial ventures in Asia and built a naval fleet to protect its lines of supply. These actions eventually led Japan into conflict with the United States.

Japanese dependence on overseas supplies made its merchant shipping a cornerstone of its industrial might. Yet, during the Second World War, Japan did not protect this fleet against attack by the use of anti-submarine warfare or protected convoys. Rather, the Imperial Japanese Navy saw its job as one of defeating the main American naval fleet. With its commerce unprotected, Japan suffered unsustainable losses to its economy and its ability to wage war. However, at the tactical-technical level, especially in naval aviation, Japanese industry and military planners were quite innovative.

Despite its acceptance of the idea of total war, Japan's decision to make war on the United States was a profound error of historic proportions as the nation's strategic objectives vastly outran its military and industrial means. Although Japan's economic growth was remarkable, its economy was still considerably smaller than that of the United States; its technology — even its military technology — seriously lagged American levels.

As contemporary Japan considers the 125 years since the Meiji restoration, the military is one of the most distrusted elements of society. Political scientists often assert that “an anti-militarist public opinion continues to mark debates on military issues.” The chief lesson Japan drew from its wartime experience is that the military is a dangerous institution that must be constantly restrained and monitored lest it threaten the postwar political and economic order. To test this assertion, we conducted a study of popular military comics, which indicated that they, too, operate under the pacifist norms of the past 50 years.

Since 1945, the conditions favorable to tactical-technical innovation, not to speak of revolution, have virtually disappeared from Japan. Resources (as a share of the economy) declined sharply from the levels of the earlier 75 years; national focus, intellectual attention, and feedback fell to insignificance. Despite the preservation of a rump military-industrial complex and its attendant government bureaucracy left over from the wartime period, their ability to conceive of and to design advanced systems and concepts is severely compromised by the pacifist environment in which they are embedded. Because of these social-political constraints, in order for Japan to have a military, it cannot act in a military way.

Two strong impressions came out of interviews. First, the pacifist sentiment in Japan was even stronger than we had imagined from our previous readings and experience. Second, tactical-technical innovation is weak and, as far as we could discover, almost nonexistent.

In summary, a deliberate Japanese role in pursuing its own military-technical revolution is unlikely unless there are historic shifts in international relations and domestic Japanese political-social norms. Other necessary conditions would include an immense gain in military-technical capabilities in Japanese industry, including the recruitment of firms and sectors now outside the defense regime. The military also would have to become seriously attentive to the threats facing the country and to its own responses at all levels, from doctrine to organization to training and systems. Such changes could take decades. Active participation of Japan in the military-technical revolution of another country other than the United States is also unlikely unless similar international and domestic political changes were to occur. Imaginative foreign users, though, could benefit from advanced Japanese products on world markets. Loose export controls could expand the selection, but this too would require major international political shifts. Renegade employees or firms could also deliberately transfer products and technologies. In a narrow area, Japan could develop a theater missile defense system using new technologies and system concepts if faced with a nation-threatening situation. Such a system would build on industry's technical strengths and would fit the Japanese concept of defensive defense. Nevertheless, as a general conclusion, Japan is an improbable source of military-technical revolution in the future.

## I. Armies and Societies

Armies, their weapons, and their ways of fighting are tightly bound to the societies that give them birth. A society's economic structure, political organization, technological capabilities, and values are among the qualities that both enable and constrain its war-making powers. Alvin and Heidi Toffler summarize this relationship by noting: "The way humans make wealth and the way they make war are inextricably connected."<sup>1</sup>

According to the Tofflers' analytical structure of successive waves of innovation and technology, so-called First Wave wars bore the imprint of the agrarian economies that gave rise to them, not just in technological terms but in organization, administration, reward structures, leadership styles, and cultural assumptions. Second Wave industrial civilization reached its peak in the World War 2 period as mass destruction played the same central role in military doctrine as mass production did in economics. The economically advanced nations are now exiting the industrial age and are being swept along by a Third Wave based on the economics of intelligent technology, information, and multi-channel communications. War, like the economy, is now becoming knowledge-driven.<sup>2</sup>

The elements of this age of warfare include knowledge of the precise location of participants (combatants on both sides and support elements), the ability to aim destructive power with high accuracy, and the capacity to plan, command, and control thousands of combat and support units in operations timed to within minutes and seconds. Among other things, these capabilities are based on a vast electronic infrastructure that requires educated, trained, and intelligent soldiers and supporting citizenry.

Whether these developments foretell of a military-technical revolution is now a much studied question, but what is less of a question is that Japan possesses many of the economic, technological, and social qualities deemed to be essential to Third-Wave warfare. Japan is a world leader in electronics technology and production. Its citizens are among the best educated in the world and their motivation has been a critical source of the nation's economic growth of the past half century. Japanese companies pioneered in reducing the time involved in development and production — one of the significant elements in the transformation of production in the last half of the 20th century that changed the way the world makes things. These contemporary strengths naturally raise the issue of the potential role of Japan in a future military-technical revolution.

In order to assess the current situation, it is necessary to look back to the period surrounding the Meiji Restoration in 1868 and the march of Japan to its defeat in 1945. It was in those years and events that many of today's policies, values, and organizations had their roots. Contemplation of a possible military-technical revolution in Japan therefore propels us on an abbreviated tour of the past. Such issues as the status of the military, economic autarky or interdependence, and government's support and guidance of industry have their roots in Japanese history.

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<sup>1</sup> Toffler, Alvin and Heidi, "War, Wealth, and a New Era in History," *World Monitor*, May 1991, p. 47.

<sup>2</sup> Toffler, Alvin and Heidi, pp. 49-52.

## II. The Path to the Present

**The Past to the Present—In Brief.** Japan's path of development was paved with irony; although the nation achieved its objectives of creating a heavy industrial system of world rank supporting a modern military establishment to defend itself against western colonialism, it also led to the one thing the strategy was intended to prevent — defeat and domination by foreigners. The growth of industry ended centuries of autarky because a modernized Japan depended on imports for its technology, energy, raw materials, and strategic industrial supplies. To ensure itself of these inputs, it embarked on its own colonial ventures in Asia and built a naval fleet to protect its lines of supply. These actions eventually led Japan into conflict with the United States. In a double irony, Japanese dependence on overseas supplies made its merchant shipping a cornerstone of its industrial might. Yet, during the Second World War, Japan did not protect this fleet against attack by the use of anti-submarine warfare or protected convoys. Rather, the Imperial Japanese Navy saw its job as one of defeating the main American naval fleet. With its commerce unprotected, Japan suffered unsustainable losses to its economy and its ability to wage war. However, at the tactical-technical level, especially in naval aviation, Japanese industry and military planners were quite innovative. Despite remarkable economic growth, though, Japan's economy was still considerably smaller than that of the United States; its technology — even its military technology — seriously lagged American levels; because of its acceptance of the concept of total war, Japan's decision to make war on the United States was a profound error of historic proportions as the nation's strategic objectives vastly outran its military and industrial means. As contemporary Japan considers the 125 years since the Meiji restoration, the military is one of the most distrusted elements of society. History suggests that this mistrust is not misplaced.

**The Threat of Colonial Domination.** The Meiji leaders created the modern Japanese state in 1868 for the express purpose of defending the nation from the technologically advanced western colonial powers. The nation would have preferred continuation of its two-century history of deliberate isolation and autarky under the Tokugawa Shogunate — a strategy that avoided foreign control by preemptively excluding foreign influence. But those in Japan looking beyond their own islands in the mid-19th century saw the colonial dominance of coastal China, the Malay peninsula, Cambodia, Vietnam, the Philippines, and the Indian sub-continent. The 1853 arrival of Commodore Matthew Perry in Japan, sent by United States president Millard Fillmore to open Japan to trade, vividly brought the foreign threat close to home. The perception of being surrounded by hostile actors fed an emotional and political sense of vulnerability that was to grow over the next century.

Astute Japanese observers of Commodore Perry's mission and other western conduct in Asia concluded that it was western technology embodied in steamships, gunpowder, cannon, and professional militaries that permitted the colonial powers to overcome the more numerous but technologically backward Asians. A growing number of Japanese outside of the central government came to believe that the preservation of independence would require jettisoning the policy of isolation in order to obtain from the West the technological capabilities and other resources required for self defense. The central government itself became alarmed by the foreign threats and in the 1850s authorized the local domains to construct large, ocean-going ships and firearms. The local arsenals became sources of independent power and provided

material support to the leaders of the rebellion against the shogunate.<sup>3</sup> By 1868 a group including local domain leaders, traditional samurai warriors, and ideologues were able to implement their ideas of national transformation with the overthrow of the shogunate and the establishment of a new government under the name of the Emperor Meiji.

The new Japanese government inherited two key assets from the 250 years of peaceful isolation that would be indispensable to its later economic development: a literate population and a rational bureaucracy. It also found that its most advanced manufacturing industry was already in armaments — although far below world standards.

**Get Rich to Get Strong.** Japanese policy of the Meiji Restoration embraced the idea of war-making as inextricably flowing from wealth-making. Japan's leaders saw that it would be necessary to create almost from scratch a wealth-making economic-social system consistent with the military capabilities it sought. Industrial growth was a means toward a political and strategic end.<sup>4</sup> The one thing that allowed Japan to adopt this strategy was that it was a late developer, a laggard. If there are benefits to being behind, it lies in this ability to observe, analyze, copy, and import from the leaders.

The system had one overriding purpose: creating modern industries and armaments as quickly as possible to protect Japan from foreigners. The nation developed elaborate and systematic methods to obtain the concepts and details of foreign achievements. Further, the Meiji government restructured the political and ideological system to remove obstacles to modernization; many of these structures, such as a civil justice system, were also borrowed from the west, but usually with local adaptations.

This military-industrial policy had as its banner the phrase “rich nation, strong army” (*fukoku kyohei*). As cogently argued by Richard Samuels of the Massachusetts Institute of Technology, this slogan became the ideological foundation of industrial and technological development during the Meiji period, even being featured on coins.<sup>5</sup> The ideology was combined with the policy of “production promotion” as the twin pillars of subsequent developments. An important aim of this policy was to make Japan independent of foreign sources of armament. Therefore, major efforts were put into mastering foreign designs and production practice. By the 1930s, almost every piece of military equipment was of indigenous origin.

The government's military-industrial subsidies, stimulated by wartime demand, created and expanded arsenals, shipyards, heavy industry, and armaments factories. By 1877, the nation's arms industry was entirely owned and operated by the government. In addition, the state also assumed ownership of the “commanding heights” of the economy (to use a Marxist phrase), although not without protracted debate. It took over transportation, communications, and heavy industry necessary for military construction. After 1880, however, most of the arms industry was privatized, largely due to its drain on the state treasury, which contributed to large fiscal deficits and runaway inflation. The shift to private production had a major

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<sup>3</sup> Samuels, Richard, *“Rich Nation, Strong Army”: National Security and the Technological Transformation of Japan*, Cornell University Press, Ithaca, 1994, pp. 81, 83.

<sup>4</sup> This period is vividly described in Fallows, James, *Looking at the Sun*, Pantheon Books, New York, 1994, pp. 89-90.

<sup>5</sup> Samuels, *“Rich Nation, Strong Army”*, p. 35.

long-term consequence as it consolidated industrial production in a small number of large, privileged suppliers with close ties to the state — the *zaibatsu*, horizontally or vertically related groups of companies usually centered around a lead bank or trading company.<sup>6</sup> Significantly, these companies were called “political merchants.”<sup>7</sup>

Another policy with long-term effects was the drive for indigenization. This view was spelled out in 1891 by Prime Minister Masayoshi Matsukata in a speech to the Diet when he declared: “To meet the needs of our national defense, the army urgently requires more weapons, better explosives, and the construction of batteries, and the navy is in dire need of warships. However, as of this time, we heavily depend on imported iron and steel in producing weapons and ships. This is not only extremely costly, but also exposes us to a high risk of not being able to obtain required supplies in the event of a national emergency.”<sup>8</sup> Japan depended on imports of natural resources from Korea and Manchuria. Embargoes by neutral countries during the wars with China and Russia, and by the United States when it cut off naval steel supplies in 1917, underscored this sense of vulnerability. Japanese military planners’ study of German experience in the First World War further convinced them that since a nation’s entire economic potential contributed to war power, nothing should jeopardize that capability.

To reduce foreign vulnerabilities, the military promoted the subsidy of domestic production, either through outright payments (as in the case of shipbuilding) or by paying prices to domestic suppliers that were higher than competing foreign goods. One observer characterized the policy in these terms: “The authorities should not refuse to use home products for materials required for military and naval industries merely on account of inconvenience or poor appearance or even though they be inferior in quality to foreign products.”<sup>9</sup>

Military planners scoured the world for military systems and technologies, perfecting a scheme of licenses plus procurement of one or two foreign items for detailed examination and reverse engineering. The military also used licenses to limit the number of firms in a field and to exclude foreign firms altogether.

Richard Samuels assesses the Japanese military-industrialization effort as a “stunning success.”<sup>10</sup> Many of the sectors that applied modern science and technologies, including the mechanical industries, copper, electric power, steel, canning, and metal fabrication, had their roots in the Meiji military establishment. By the 1890s, Japan was exporting small arms, machine guns, and naval equipment.

The navy especially benefited from the growth of heavy industry. Navy leaders believed that fleet size was not always crucial, but because of technological innovation adopted by foreign navies, quality was of

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<sup>6</sup> Samuels, “*Rich Nation, Strong Army*”, p. 86.

<sup>7</sup> Samuels, “*Rich Nation, Strong Army*”, p. 40.

<sup>8</sup> Quoted in Yamamura, Kozo, “Success Illgotten? The Role of Meiji Militarism in Japan’s Technological Progress,” *Journal of Economic History*, March 1977 (Vol. 37, No.1), p. 126.

<sup>9</sup> Quoted in Samuels, “*Rich Nation, Strong Army*”, p. 89.

<sup>10</sup> Samuels, “*Rich Nation, Strong Army*”, p. 87.

central importance.<sup>11</sup> In the naval victory at Tsushima against the Russians in 1905, not one of the principal ships had been built in Japan. By 1920, Japanese shipyards were able to build capital ships using solely domestic labor and material. Less than 10 percent of the fleet was imported in the 1920s. In 1922, domestic shipyards completed their first aircraft carrier — the first ship in the world to be built from the keel up as an aircraft carrier.<sup>12</sup> They launched large, long-range diesel cruiser submarines (I-boats) that incorporated the best of European technology two years later. Already, by 1921, the Imperial Japanese Navy was the third largest in the world.

**The Size and Effect of the Military Economy.** Unlike the Soviet Union, military power in Japan was not an end in itself; consumption was not viewed as a drain on the system. But, neither was the civil economy treated with the same degree of state largess as was military industry. The civilian economy grew rapidly from high rates of investment and competitive markets. Military investment, which averaged 25 percent of total gross capital formation at the turn of the century, fell to 14 percent after 1917. Although civilian growth was in large part independent of the military-industrial sector, it also benefited from the transfer of technology, management experience, personnel, equipment, and supplies from military industry to civilian firms. By the end of the Meiji era in 1912, the larger shipyards, to take one example, produced locomotives, railroad cars, turbines, and a variety of machinery for the private sector.<sup>13</sup>

Military demand grew into a sizable share of total economic output, especially during the Sino-Japanese war of 1894-95 and the Russo-Japanese war ten years later. On both occasions, military orders saved struggling private firms from extinction; in addition, aggregate military demand underwrote the economy when it could have slipped into severe recession.<sup>14</sup>

Although the stimulation of military industry was one of the main motives behind the Meiji Restoration, neither the Diet (parliament) nor government ministers were willing to write blank checks to the military. In general, the financial position after 1905 was one of stringency and the armed forces had to compete for scarce resources.<sup>15</sup> Even after its acclaimed victory over Russia, Japan remained a small, poor country with limited opportunities to tap the international credit markets.

The military services, though, were well placed to exert influence. For example, from 1898 to 1918, generals or admirals were prime minister six times, extending over 13 years. The military prime ministers were pressured by the Diet to cut budgets and by the military to increase armaments and production capacity. Inevitably, the army and navy were drawn into politics and participated in the higher national policy-setting councils.

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<sup>11</sup> Boyd, Carl, "Japanese Military Effectiveness: The Interwar Period," in Alan R. Millett and Williamson Murray (eds.), *Military Effectiveness: Vol. 2, The Interwar Period*, Unwin Hyman, Boston, 1988, p. 135.

<sup>12</sup> Boyd, "Japanese Military Effectiveness: The Interwar Period," pp. 136-137.

<sup>13</sup> These points are documented in Yamamura, "Success Illgotten?," p. 124.

<sup>14</sup> Yamamura, "Success Illgotten," p. 113.

<sup>15</sup> Ian Nish, "Japan, 1914-18," in Alan R. Millett and Williamson Murray (eds.), *Military Effectiveness: Vol. 1, First World War*, Unwin Hyman, Boston, 1988, p. 230.

from the 1880s until 1940;<sup>16</sup> Japan's military budget was as large as America's despite an American economy that was more than eight times greater.<sup>17</sup> (See Figure 1.) The factor accounting for the size of Japanese spending was that it devoted roughly an eight times higher share of its gross national product to defense than did the United States. (See Figure 2.) Except for the First World War, United States spending on military affairs was under the one-percent level, compared to six percent or more for Japan. Japan's expenditures for the war in China reached 10 percent of GNP in 1894-95 and rose to 30 percent in the 1905 Russian war.

The Washington Naval Conference of 1921-22, which imposed a 10-year moratorium on Japan's capital ship construction, held down budgets during this period. Throughout the 1930s, Japanese spending grew rapidly from 4 percent of GNP to more than 20 percent by the end of the decade. Even though Japan sacrificed almost two-thirds of its entire economic output to the military in 1944, the sheer size of the American economy and its overwhelming productivity advantage allowed the United States to out-produce Japan by a factor of eight in 1944.<sup>18</sup> (See Figure 3 for GNP comparisons.)

Japanese GNP grew by a factor of 6, or 3.7 percent annually, from 1890 to 1940. (Almost exactly the same growth rate was experienced from 1970 to 1990 in the period following the post-war growth spurt.) This healthy growth of the overall economy, which was stimulated by military demand and military technology, enabled military spending to advance at equally rapid rates. In comparison, the United States economy grew at a still enviable three-percent rate during the fifty years from 1880 to 1940.

It is still not clear as to whether the net impact of the military on Japanese growth was positive or negative. The main items on the positive side are the importation, absorption, and dissemination of technology. Closely related is the military sector's production of advanced products for sale to civilian industry. A third possible contribution is the military addition to aggregate demand that would stimulate an economy operating below capacity. Arguments for a negative economic impact of the military include the diversion of investment to low-return military-industrial uses at nonmarket prices, high taxes and inflation that discouraged private investment, the waste of resources on colony-building and war, and a Japanese economy that did tend to operate below full-employment rates — with or without military demand stimulation.

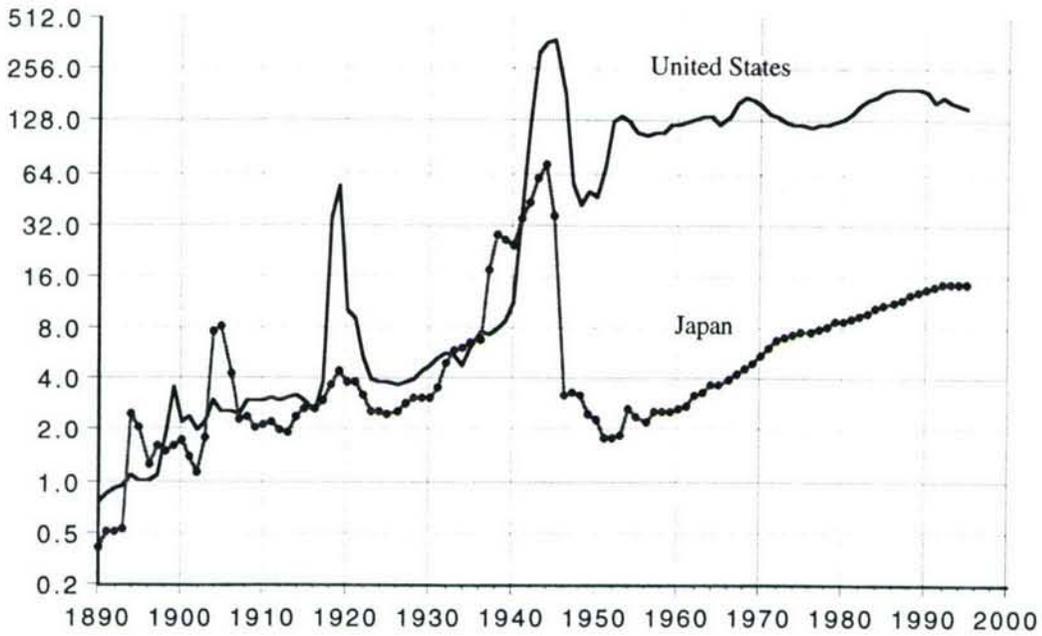
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<sup>16</sup> United States and Japanese defense spending and GNP data were provided in an unpublished paper by Ward, Michael D., David R. Davis, and Corey L. Lofdahl, *A Century of Tradeoffs between Defense and Growth: the Case of Japan and the United States*, Center for International Relations, University of Colorado, Boulder, February 1994. Sources for these and other data are shown in the next footnote.

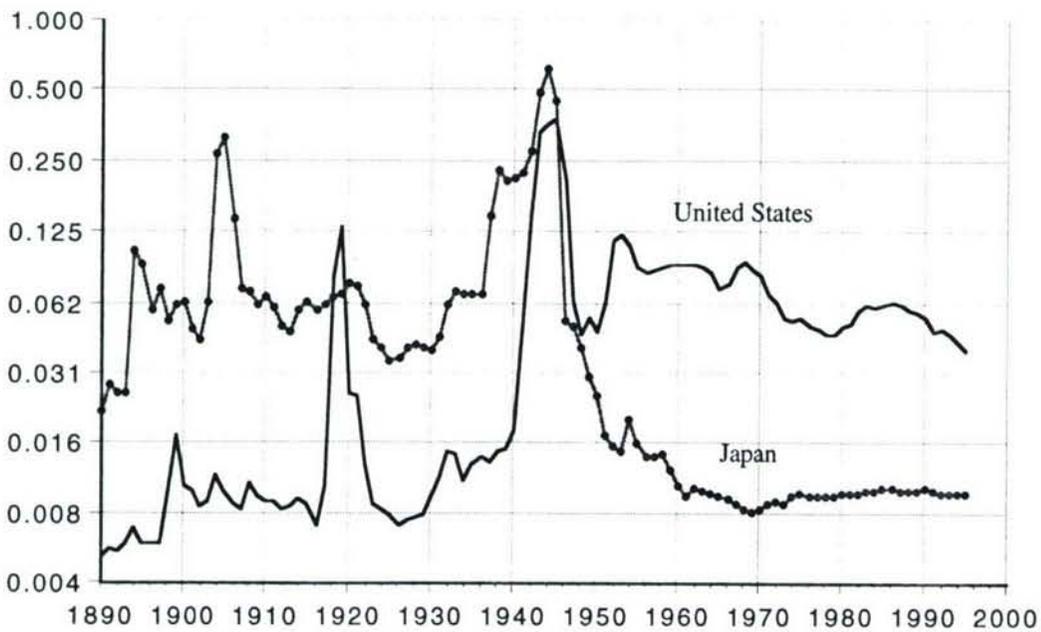
<sup>17</sup> Note that the vertical scale in these figures is logarithmic — each division is twice as great as the one below it. Japanese GNP in constant 1980 yen was converted to dollars using a 1980 purchasing power parity figure of 250 ¥/\$, as estimated by the Organization for Economic Cooperation and Development (OECD). (The 1980 exchange rate was 227 ¥/\$.) U.S. data in figures 1 and 2 are taken from: U.S., Bureau of the Census, Washington, DC, *Historical Statistics of the United States*, 1976 and U.S., *Economic Report of the President*. Japanese statistics are from Bank of Japan, *Hundred-Year Statistics of the Japanese Economy*, Tokyo, July 1966 and Japan Statistical Agency, *Japan Statistical Yearbook*.

<sup>18</sup> Estimates of Japanese GNP and military spending in the period 1944-46 are particularly unreliable. Moreover, all of these relations over time and across countries must be treated cautiously.

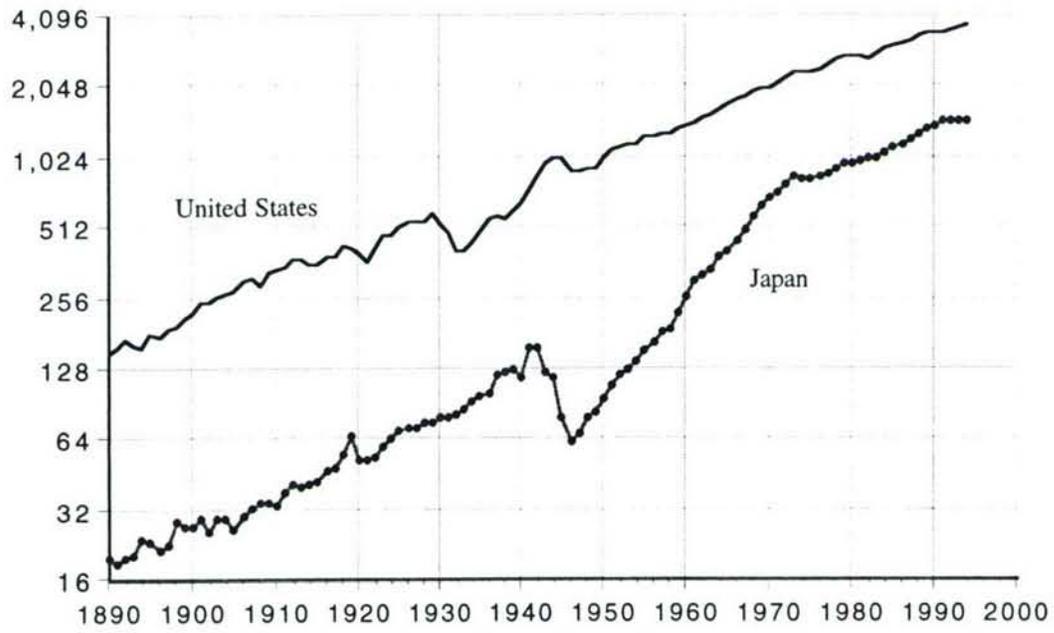
**Figure 1: U.S. and Japan Military Spending, Billion 1980 \$**



**Figure 2: U.S. and Japan, Ratio Military Spending to GNP**



**Figure 3: U.S. and Japan GNP; Bn 1980 \$**



The Japanese path of industrial development followed the “normal” sequence of agriculture, food industries, and textiles followed by more rapid growth of the metal, machinery, and chemical industries. One study concluded that Japan did not reverse this traditional order, but proceeded more quickly along the traditional course.<sup>19</sup> Japan’s growth rate of manufacturing output was not faster than the pre-1914 experience in Sweden, Canada, Italy, and the United States. What distinguished Japan from the western economies was the speed of transition from an agrarian to an industrial nation; military priority seems to have been the key to this speedy transition.

Military demand and investment were important contributors to a widening gap within Japan in technology, productivity, and wages. This “dual economy”, based on the unbalanced development of heavy industry relative to the rest of the economy, was to plague prewar Japan with social and political conflict and to have echoes that continue to be heard today.<sup>20</sup> The mobilization and allocation of demand and production capacity to favor military output left Japan after the war with a grossly distorted production sector — an enormously expanded heavy industry and drastically curtailed civilian sector and light industry.

Government was a key actor in stimulating military technology and promoting its dissemination throughout the economy; it inculcated a mind-set in industry to seek ideas and technologies worldwide; and it encouraged a cooperative attitude between government and companies associated with arms production.

**Military Influence in Politics and Industry.** Spending on the military was never automatic. The Diet and Finance Ministry had to consider the broader implications of taxes, government debt, inflation, foreign credit, trade balances, and alternative spending programs. Nevertheless, the very origins of the state in the Meiji Restoration preordained military priority.

The balance between military demands and political-fiscal claims began to shift in the 1930s. Assassinations by right wing extremists and military plotters of political leaders trying to control the military were important steps in the military’s usurpation of political power. The first of these assassinations, presaging events a decade later, was the 1921 stabbing of Prime Minister Kei Hara, who had promoted commercial over military development. Also supporting the military’s rise to power were such structural features of government as the constitutional right of army and navy ministers to report directly to the emperor (the prime minister was the only other official with such a right); the military members of the cabinet also had the right to force the collapse of the government by withholding their support of a motion. The army created dramatic incidents abroad, in Manchuria, China, and Korea, on which national prestige was said to be at stake, presenting the foreign minister with a *fait accompli*.<sup>21</sup>

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<sup>19</sup> Shionoya, Yuichi, “Patterns of Industrial Development,” in Lawrence Klein and Kaushi Ohkawa (eds.), *Economic Growth: The Japanese Experience since the Meiji Era*, Richard D. Irwin, 1968, p. 78.

<sup>20</sup> Rice, Richard “Comment,” on Yamamura, *Journal of Economic History*, March 1977, p. 137. The echoes of dualism continue to be heard today as Japan struggles with large segments of the economy such as food processing and light industry whose productivity lags world standards by more than 50 percent.

<sup>21</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 141.

Throughout the interwar period, the military promoted its control over industry. The Diet passed the Munitions Mobilization Law in 1918, which allowed the military to assume control of critical industries during wartime. In 1927, the Army secured Diet approval of a Cabinet Resources Bureau with unlimited jurisdiction over industrial mobilization. The Important Industries Control Law of 1931 established control associations to secure closer coordination between government and industry; the associations were essentially cartels under government leadership. Expansionary central government budgets aimed at increasing aggregate demand to relieve the effects of the Great Depression in Japan favored agriculture — a particularly hard hit sector — and the military; the military, though, received the bulk of the allocations with its share of the government budget doubling from around 30 percent in 1931 to more than 60 percent six years later. Specific relief programs directed to military industries included funding for plants to extract magnesium from seawater, aluminium smelters, and synthetic fuels.<sup>22</sup>

Sharp increases in industrial imports in the 1930s from non-Asian countries contributed to large trade deficits, which the government tried to control by placing limits on imports for consumption. This move had the unintended consequence of worsening the trade imbalance because it reduced the supply of raw materials for textile production, which was Japan's leading export. To maintain the demand and supply balance, government control was extended to most economic activities.<sup>23</sup>

The Japanese private sector profited from its involvement in military production. Nearly three-quarters of Japanese weapons came from private firms. Government factories predominated only in guns, ammunition, and gunpowder. The firms found ways to cooperate without giving up managerial authority. For example, although military production was said to be very profitable for the *zaibatsu*, even at the brink of war arms output at the principal firms was less than 20 percent of their total sales.<sup>24</sup> Another example of companies fending off government authority was their control over state control associations; these were chaired by top *zaibatsu* executives and worked with government to designate the military contractors in each industrial sector. In a 1940 battle over the state's right to control industry, the government proposed a "New Economic Order" to eliminate private participation in the control associations. Industry managed to block this move.

The older *zaibatsu* families such as Mitsui, Mitsubishi, Sumitomo, and Yasuda had benefited from the patronage of the Meiji government. The owners of these firms maintained close contacts with politicians and bureaucrats. The growing military influence in the 1930s, however, tended to drive a wedge between the industrialists and the government. The conservative companies drew criticism from right-wing ultranationalists who demanded arms production uncorrupted by the greed of profits. Although the older *zaibatsu* managed to adjust their private interests to fit those of the government, they were somewhat conservative when it came to new ventures.<sup>25</sup> In particular, they were sometimes slower than the military

<sup>22</sup> Much in these paragraphs comes from Samuels, "*Rich Nation, Strong Army*", pp. 93-107.

<sup>23</sup> Ono, Naoki, *Learning the Reality of a Sustainable Alliance*, dissertation submitted to the Johns Hopkins University, Baltimore, 1994, p. 106.

<sup>24</sup> Samuels, "*Rich Nation, Strong Army*", p. 101.

<sup>25</sup> Boyd, "Japanese Military Effectiveness: The Interwar Period," pp. 137-138.

desired in adopting new technologies and they were skeptical of investing in the Japanese colony in Manchuria. Several newer *zaibatsu* that pursued policies more to the government's liking were actively supported with military orders and concessionary finance. Two of these were Nakajima Aircraft (today, Fuji Heavy Industries) and Nippon Sangyo (Nissan). The army was primarily responsible for the success of Yoshisuke Aikawa after he consolidated Nissan's holdings, reorganized them, and expanded the firm throughout the 1920s. Through military orders, he expanded his business activities to control 77 companies by 1938. Among today's survivors of the Nissan empire are Nippon Mining, JVC, Hitachi, and Nikon. Although the company concentrated on military vehicles and heavy chemicals, Nissan was chosen as a lead investor and developer of Manchuria.<sup>26</sup> After receiving very favorable financial support from the government in 1937, Aikawa moved the headquarters of Nissan to Manchuria to better oversee his Manchurian industrial developments.

As military production grew to record wartime levels, coordination of industry began to break down because of confused authority and bureaucratic rivalries, but especially because of the almost implacable competition and impenetrable boundaries between the Imperial Japanese Army and Imperial Japanese Navy. The differences between the services derived from different clan origins of officers, from competition for budgets, and from different styles of professionalism (the army emphasizing fighting spirit and the navy technical competence). The army considered Russia and China with their great land armies on the land mass of Asia as its traditional foes, whereas the navy looked at the Pacific fleets of the United States and Great Britain. The Japanese armed forces were no better integrated between 1941 and 1945 despite wartime necessities than they had been before the war. "They visualized different enemies and fought different wars."<sup>27</sup> Governments tended to temporize rather than coordinate the policies of the armed services. A reluctance to tamper with the concept of an autonomous service responsible only to the emperor resulted in the absence of a permanent mechanism to integrate military affairs.

Institutional barriers extended to the services' suppliers; it was usual that separate facilities and even separate companies were selected as contractors for the army and navy for the same product. The government attempted to bring some order to industry and procurement in 1943. It consolidated government procurement authority in a single Ministry of Munitions — the antecedent of today's Ministry of International Trade and Industry (MITI) — and tried to enforce corporate consolidations. "Neither measure worked as intended, for neither service would accept civilian control."<sup>28</sup> Samuels emphasized the difference between the formal structure and the reality of these policies by noting: "In the annals of capitalism, the gap between de jure supervisory powers and de facto control has rarely been greater."<sup>29</sup>

**The Effectiveness of Tactical-Technical Developments.** The rise of direct military involvement in political affairs, culminating in the military takeover of power in the 1930s, was accompanied by a growing inconsistency between strategy and the means to implement it. Moreover, military doctrine came

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<sup>26</sup> Boyd, "Japanese Military Effectiveness: The Interwar Period," p. 138.

<sup>27</sup> Coox, Alvin D., "The Effectiveness of the Japanese Military Establishment in the Second World War," in Alan R. Millet and Williamson Murray (eds.), *Military Effectiveness: Vol. 3, The Second World War*, Unwin Hyman, Boston, 1988, p. 23.

<sup>28</sup> Samuels, "Rich Nation, Strong Army", p. 105.

<sup>29</sup> Samuels, "Rich Nation, Strong Army", p. 362.

to be stubbornly rooted in past successes with little adaptation to changing technologies or the capabilities of real and potential enemies.

Japanese military industry was different. From the Meiji Restoration in 1868 until 1945, this high-priority sector was driven by the intense anticipation and actuality of war and defense. Writers on military-technical revolutions note that competition and feedback are two of the conditions that govern the speed of a major transformation. One writer notes, for example, that the myopia over the destructive effects of improved artillery and the machine gun in the First World War “was induced in part by the fact that no large-scale fighting occurred among the great powers” for almost 50 years.<sup>30</sup> Myopia at the tactical-technical level was not a problem in Japan. Resources, intellectual attention, national focus, and feedback were brought to bear on military-industrial affairs. In addition, the industrialists participated actively in the international arms market as avid seekers of the best weapons and technologies. Because of this exposure, they were not isolated from contemporary developments outside of Japan as many were in the military high command. Thus, post-1868 policy created and nurtured a competent military industry and technology as well as some important tactical-technical innovations as evidenced by the attack on Pearl Harbor and the design of the Zero fighter. Such innovation, though, did not extend to the broader areas of doctrine and organization.

Military technology is most effective when used with appropriate tactics in a reasonable doctrinal setting. Japan, especially the Imperial Navy, produced some highly competent weapons in the decades leading up to its Pacific war; it combined these systems with imaginative and innovative tactics. Yet, the services were wed to obsolete doctrine that doomed them to destruction and national defeat.

Military historians describe the war with Russia in 1904-05 as “Japan’s supreme experience of war.”<sup>31</sup> The naval battles at Tsushima against Russia and the earlier victory at the Yalu against China were embodied by the Japanese military as “tradition-making” events.<sup>32</sup> Japanese military participation as combatants or observers in the First World War was quite limited, although Japan sent a naval squadron to the Mediterranean to assist the British in convoy duties. The British military attache to Japan noted that Japanese training in 1917 employed the same tactics as had been used by the Western armies in “those far-off days of August 1914.”<sup>33</sup> In aviation, too, the gap between Japan and the west in technology and air crew proficiency widened. Japan, therefore, entered the 1920s with Tsushima defining the essence of warfare. As an analyst of Japan’s Second World War effectiveness concluded, “Battles fought during the Chinese conflict and the Pacific war are eerily reminiscent of the wars of 1894-95 and 1904-05. What was effective against the Ching and Romanov dynasties ought to be similarly effective against the foes of the mid-twentieth century.”<sup>34</sup> Suffused by the spirit of the offensive to the neglect of most other military qualities, one observer summarized that “the mystical typically dominated the logistical in Japanese tactical

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<sup>30</sup> Krepinevich, Andrew F., “Cavalry to Computers: The Pattern of Military Revolution,” *The National Interest*, Fall 1994, p. 35.

<sup>31</sup> Nish, “Japan, 1914-18,” p. 235.

<sup>32</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 149.

<sup>33</sup> Nish, “Japan, 1914-18,” p. 243.

<sup>34</sup> Coox, Alvin D., “The Effectiveness of the Japanese Military Establishment in the Second World War,” p. 34.

philosophy.”<sup>35</sup>

As the military’s influence over the government grew during the late 1920s and 1930s, its limitations and its strengths produced a paradoxical combination of tactical-technical innovation and strategic disaster. First, the limitations. As noted above, the army and navy, for the most part, could have been in separate countries. Although there were periods of effective coordination — the 1937 battle of Shanghai, for example, where naval air power significantly assisted ground operations — traditional army-navy rivalry often jeopardized effectiveness at both the operational and tactical levels. Thus, despite the naval air success over China, naval aviators resented their ground target assignments, preferring instead to attack grander targets — the enemy’s main fleets — as their training and doctrine had prepared them; consequently, dissatisfaction grew, morale suffered, and tactical effectiveness was impaired, “not only against the Chinese in the 1930s, but also in the war against the Anglo-American powers in the 1940s.”<sup>36</sup>

Naval doctrine and forces were designed to protect Japan’s commerce and to promote Japan’s political, economic, and military hegemony in the Western Pacific. The operational doctrine to accomplish this task was to attack the enemy’s main fleets — following the lessons learned at Tsushima and by study of European main battle fleet experience. Naval operational doctrine reflected the admirals’ obsession with the battle fleet; destroyers, for example, were to escort capital ships only. There were no Japanese naval units with the main mission of protecting merchant ships. The navy was indifferent to and ignored convoy escorts. This offensive focus also led the navy to ignore anti-submarine warfare. “The vested interests of the most traditionally-minded admirals prevented the development of an effective operational doctrine that could come to grips with some of the changes occurring in naval warfare.”<sup>37</sup> Because the navy had become a victim of its previous rigid thinking, it allowed the nation to suffer horrible losses of materiel and manpower; during the Second World War, 700 naval vessels were destroyed and 2,300 merchant ships were lost — 55 percent to American submarines. The United States Strategic Bombing Survey concluded that the Japanese oil industry was “already defunct” because of a lack of crude oil by the time the long range B-29 bombers began their raids in 1944. Prime Minister Higashikuni told the Diet in September 1945 that “the basic cause of defeat was the loss of transport shipping.”<sup>38</sup>

The military services also paid scant attention to their own logistics needs. Logistics took a distinctly second place to operations in staff work; this negligence created serious deficiencies in operations. The army was plagued by ammunition shortages; its communications were chronically poor. Wheeled and tracked transportation was primitive. The medical service was plagued by drug shortages and poor evacuation capabilities.<sup>39</sup> The main naval fleet’s “hallmark of operational ineffectiveness was the small and slow fleet of oil tankers;” while the fighting ships were fast enough and had the range to strike offensively

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<sup>35</sup> Quoted by Coox, Alvin D., “The Effectiveness of the Japanese Military Establishment in the Second World War,” p. 39.

<sup>36</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 163.

<sup>37</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 149. Much of the description and analysis in this paragraph is taken from Boyd.

<sup>38</sup> Coox, Alvin D., “The Effectiveness of the Japanese Military Establishment in the Second World War,” pp. 20-21.

<sup>39</sup> Military values played a role in the poor medical care for casualties; non-ambulatory soldiers were regarded as having lost their *raison d’être*. Coox, “The Effectiveness of the Japanese Military Establishment in the Second World War,” p. 27.

at a distance, naval logistics could not support such operations.<sup>40</sup> “Perhaps the greatest shortcoming was a dearth of fuel and ammunition.”<sup>41</sup>

The ironic counterpart to the Japanese navy’s operational rigidity was a high degree of innovation at the tactical-technical level. Throughout the 1930s, expectations of war focused naval minds on realistic preparations, including planning, training, and experimentation that tested new weapons and tactics. Realistic training was used to learn about the capacities of Japanese sailors and the qualities of equipment. A western naval analyst in 1935, reporting in the U.S. Naval Institute’s *Proceedings*, observed that the newer Japanese ships had “higher fighting qualities than American or British ships.”<sup>42</sup> The forces were described as well-balanced and splendidly trained.

In fleet exercises, the Japanese experimented with carrier air forces to test the effectiveness of bombers, torpedoes, and torpedo bombing.<sup>43</sup> In 1930, with the availability of new carriers, navy pilots began experimenting with dive bombing as a new method of attack. Through such experiments — including the development of special sights — and subsequent training, they achieved a much greater degree of accuracy and destructive power than through conventional high-level bombing. In an experiment of the effectiveness of dive bombing in 1930 against an old cruiser, however, the ship remained afloat despite three direct hits. It was finally sunk by torpedoes launched by a destroyer. This experience led to a new emphasis on torpedoes, including aerial delivery. Torpedo designs were constantly refined and experiments were conducted on aircraft delivery techniques. These became so successful that they were added to the standard repertoire of naval aviation.

One of the most innovative Japanese weapon of the Second World War was a giant oxygen-propelled torpedo, two feet in diameter, almost 30 feet long, and weighing three tons (the Model 93, Long Lance). With a top speed of 49 knots (slightly faster than American and British models), the maximum range of 21 miles was four times greater and the warhead was 60 percent heavier than the best foreign torpedoes. Moreover, these torpedoes created little wake. Tacticians, however, were unsuccessful in the early 1930s in convincing the battleship-dominated high command of the worth of such weapons until they demonstrated their capabilities in a dramatic experiment. Two old battleships with especially prepared 9-inch armor were used as experimental targets. Only three torpedoes were required to sink each battleship. Thereafter, funding was assured and torpedoes became “one of the most outstanding technical achievements of the Japanese navy in the interwar years.”<sup>44</sup>

The fighting in China also produced feedback that led to tactical developments and refined the requirements for new weapons. One example was noteworthy. Long-range bombers and their fighter escorts were launched from separate bases, rendezvousing near the target. One reason for this tactic was the shorter range of the fighters. However, when bad weather prevented the aircraft from joining, the bombers

<sup>40</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 153.

<sup>41</sup> Coox, “The Effectiveness of the Japanese Military Establishment in the Second World War,” p. 27.

<sup>42</sup> Prak, W. “Problems of the Pacific: Causes for War,” U.S. Naval Institute, *Proceedings*, July 1935.

<sup>43</sup> This paragraph is largely taken from Boyd, “Japanese Military Effectiveness: The Interwar Period,” pp. 148-164.

<sup>44</sup> Boyd, “Japanese Military Effectiveness: The Interwar Period,” p. 159.

suffered devastating losses. This experience led to the two types of aircraft flying in formation the whole way; this tactic required long-range fighters, which resulted in the specification for what was to become the Mitsubishi Zero, perhaps the most famous Japanese system of the Second World War.

With the development of long-range naval aviation plus effective ordnance and delivery techniques, it was thought by 1940 that fast carriers might project firepower deep into enemy territory. In early 1941, this new naval air concept was being tested in fleet maneuvers. At that time, the navy staff confronted a deep dilemma dealing with the possibility of American intervention in planned Japanese movements to the south. A bold plan emerged for an air attack on the United States fleet at Pearl Harbor. This idea was a sharp departure from conventional doctrine, but only an innovation could solve the Japanese dilemma. All types of carrier aircraft using most kinds of available weapons were to be utilized. In this way, the effects of possible countermeasures to any one weapon would be minimized. The navy carefully studied logistics and carried out fleet exercises to test rendezvous procedures with refueling tankers. This imaginative and extremely effective operation, though, did not signal an actual change in the thinking of the traditional, battleship admirals. Implementation of the Pearl Harbor plan is usually attributed to the imagination and forcefulness of the commander of the combined fleet, Admiral Isoroku Yamamoto; a former chief of technology at the navy's air staff office, he was not able to transfer his openness to new ideas to his colleagues in the naval leadership.

**The Mitsubishi Zero Fighter.** The Zero fighter has been acclaimed as one of the best aircraft of the Second World War and the epitome of Japan's industrial, technical, and military design capabilities. In many ways it was all of these things, but even more the Zero represented the art of tactical-technical tradeoffs. The aircraft's design reflected many of the shortcomings of Japanese industrial capabilities; informed choice, cleverness, and luck substituted for technology.<sup>45</sup> These qualities were abetted by a decade of intense development experience in new aircraft, stimulated in part by a 1932 government program to procure only airframes and engines designed in Japan. Feedback from realistic training, experimentation, and warfare was as important as design and production experience.

The Washington Treaty of 1921 imposed tonnage restrictions on Japan's battleships, battle cruisers, and aircraft carriers, but no restrictions were placed on naval aircraft. Japanese military planners saw air power as a solution to the fleet restrictions. The Japanese navy turned to Great Britain for assistance and 30 British naval officers arrived in Japan in 1921 to train pilots and discuss aircraft, equipment, and tactics with their Japanese counterparts. One bit of British advice that was to reappear with particular relevance 15 years later was that long-range, land-based aircraft could supplement scarce carrier-based assets to provide air cover for attacking forces.

The British connection was extended when Mitsubishi hired the British aircraft designer Herbert Smith in 1921 from the Sopwith company to assist with a Japanese navy contract to design and build carrier aircraft. The Type 10 biplane that came out of this venture was the first fighter anywhere designed

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<sup>45</sup> The description of Zero development is taken from Mikesh, Robert C., *Zero*, Motorbooks International, Osceola, WI., 1994. This book made use of interviews with participants, Japanese and United States archives and intelligence reports, autobiographies, and direct flying experience with extant copies of the Zero.

expressly for carrier operations and the first of five generations leading to the flight of the Zero in 1939. The second generation, appearing in 1928, was the Type 3, a British Gloster design built by Nakajima. The third generation Nakajima Type 90 flew in 1931; a refined version, the Type 95, was adopted in 1935. The Mitsubishi fifth generation, the Type 96 (A5M), was the first low-wing monoplane built for carriers. Entering into service in 1937, Japan reached a world standard in capabilities with this model.

The Type 96 evolved from a 1932 experimental design project. Although everyone concerned with this project considered it a failure because the specifications could not be achieved with the available technology, the Mitsubishi design group, including a young engineer who would be appointed chief designer of the Type 96, gained a good deal of experience in working out the problems associated with advanced requirements. The Type 96 was notable in several respects; first, its designer, 31-year old Jiro Horikoshi, would go on to become the creator of the Zero. Second, the Type 96 incorporated the kind of tactical-technical tradeoffs that were the essence of the success of Horikoshi's next project. Many Japanese pilots, like their counterparts around the world, objected to the loss of maneuverability entailed in going from a biplane to a monoplane, despite the gain in speed and range. The standard United States navy fighter in the mid-1930s was the Grumman F3F biplane. Given the doctrine of one-on-one dogfighting, the low-speed maneuverability provided by two wings was considered to be at the core of getting a jump on the enemy. However, when used in China, the Type 96 monoplane quickly dominated the highly maneuverable Soviet Polikarpov biplanes used by the Chinese. Other technical advances were also considered, including retractable landing gear and a closed cockpit to reduce drag, but both were rejected in favor of lower weight. Drag reduction was achieved by perfecting flush riveting and skin smoothness, but this required a highly competent manufacturing workforce. However, an inverted gull wing, chosen to shorten the length of the landing gear, was later dropped for a conventional straight wing to simplify production. More than a thousand of the Type 96 were built through 1940.

Both Mitsubishi and Nakajima received the specifications for an experimental fighter in May 1937. The requirement pushed range, speed, and maneuverability beyond what any single Japanese aircraft had heretofore attained. On reviewing the specifications, Nakajima withdrew from the competition. The 1,685 nautical mile range was the most demanding of the specifications, but was called for because navy bombers were being shot down through lack of protection over China when their escorts did not have the legs to accompany them over their targets.

Minimizing drag and weight was seen as the solution to many of the design problems. Retracting landing gear and a closed cockpit now became essential, but the weight issue remained. Horikoshi decided to shave the safety factors on less critical parts to save structural weight. He thought that the standard safety factor of 1.8 applied to the navy's specification of withstanding seven times the force of gravity (7 g's) was too stringent — not every part would be exposed to 12.6 g. He also did away with wing attachment joints, a standard feature on naval planes to save space on cramped carriers — but one that required heavy fittings; instead, he devised a means to separate the front and rear fuselage to accomplish the same purpose without the weight penalties. The single, one piece wing spar was the heaviest structural member; Mitsubishi was lucky in that a new aluminum alloy pioneered by Sumitomo Metals Company, Extra Super

Duralumin, was stronger and lighter than other comparable aircraft alloys.<sup>46</sup> This material was known to develop severe intragranular corrosion, but for the relatively short expected life of a fighter aircraft, this was not considered a serious problem. (During the Second World War, Soviet aircraft designers planned on a one week combat life.)

Despite headway being made in the design, after almost a year of work the specifications were still not being met. Sufficiently powerful engines were a continuing problem. Japanese engine performance had typically been a generation behind western models and the engine and propeller projects for the Zero were running behind schedule. Japanese aircraft designers had learned how to make do with what was available by dispensing with all but the most essential features and accessories; with a requirement as demanding as the current project, though, engine availability was creating a serious problem. A meeting was called in April 1938 between the manufacturer, the navy's aviation bureau, and several distinguished naval air commanders. Horikoshi stated that the combination of specifications could not be met with the available technology and asked for guidance. One highly respected navy air commander — a combat leader, test pilot, and tactician — argued that close-in fighting was the single most important characteristic of a naval fighter and that range, speed, and heavyweight cannon could be sacrificed. Another combat commander with equal qualifications vehemently opposed this view, saying that Japanese bombers were being shot down over China and that range and speed were required. In his view, pilot skill could make up for maneuverability. The meeting concluded without decision, but the Mitsubishi design team was asked to review the requirements with the various views in mind. Thus, the company was put in the position of resolving the dilemma that the military authorities could not accomplish on their own.

Horikoshi literally went back to the drawing board; after further analysis of all the variables, he came to the conclusion that the job could be done with his original layout if he were allowed to continue. The navy gave full support to the project. The first flight took place on April 1, 1939. One problem that came to light was overly sensitive elevator controls at high speed. Several complicated and weight-increasing solutions were contemplated; the chosen one was to induce an elastic action in the control cables. The engineers worried that this could produce either a spongy, nonresponsive action or high-speed flutter, or both. By a combination of either luck or engineering genius, the idea worked without either of the feared side effects; it was patented in 1940 and was used in other countries after the war.

Production began at a slow pace in early 1940 and built up to 30 per month within a year. Mitsubishi reached a peak monthly production rate of 145 in October 1944; in September of the same year, Nakajima produced 245 Zeros. From the beginning of 1940 until the end of the war in mid-1945, 10,815 Zeros were built in five factories. Nakajima produced 6,220, more than the 3,800 built by the designer company Mitsubishi.

The very first production aircraft were sent to China along with factory technicians and engineers to carry out modifications shown to be necessary by combat. The Zeros very quickly dominated the skies and the Chinese refused to engage in combat with their obsolete Soviet fighters. The United States had received

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<sup>46</sup> Horikoshi claimed that the aluminum alloy was an indigenous product, but other sources said it was imported. Samuels, *"Rich Nation, Strong Army"*, p. 121.

intelligence reports of this new aircraft but had not given them much attention. Carrier-based Zeros participated in the attacks on Pearl Harbor; land-based Zeros from Taiwan attacked the Philippines, the latter involving a round trip of a thousand miles. Against Pearl Harbor, 125 Zeros were involved and all but nine returned home. Over Singapore, nine Japanese fighters encountered 12 RAF Hawker Hurricanes, five of which were destroyed versus either two or no Japanese losses. In the next several months, the Zeros caused devastating losses to British Hurricanes and Spitfires and to American P-40s and P-36s. American pilots, though, gradually developed tactics to counter Japan's superior aircraft. They found that they could not out-maneuver the Zero, but they could out-dive it. American pilots also used mutually protective tactical formations and hit-and-run attacks. Until a new generation of American aircraft reached the Pacific in late 1942 and early 1943, the Zeros usually prevailed in dogfights. After that time, though, improved and more numerous American aircraft, better trained pilots, and new tactics started to make life very dangerous for the Japanese flyers who were younger and less well prepared than their predecessors of just two years earlier. Perhaps the most devastating blow came in the battle of the Philippine Sea in June 1944 when 370 Japanese planes in four waves were shot down by American aircraft waiting at high altitude. By October 1944, the Japanese forces began using *kamikaze* attacks against the American fleet; more Zeros were used in these attacks than any other aircraft. In the Battle of the Philippines in October 1944, 331 Zeros were launched in *kamikaze* operations, 158 of which reached their targets. At war's end, plans were in place to use every available Zero and other aircraft in a *kamikaze* defense of the main Japanese islands.

A Japanese aeronautical engineer summed up the Zero's positive and negative qualities in one word — flimsy. The light weight and long range was compromised by weak structures that did not accept damage well. A famous Zero ace assessed the main advantage of the aircraft as its range; he had once flown for 12 hours and 5 minutes. He felt that the low engine power was perfectly matched to the light airframe. The worst points in his estimation were the radios and lack of self-sealing fuel tanks and pilot armor, both of which were absent in 1937 vintage designs in all countries but which were added in later years in foreign fighters although not in the Zero. American intelligence analyses of captured Zeros suggested that the best tactic was: "Do not attempt to dogfight against the Zero." Instead, American fighter pilots were advised to make use of the Zero's weak points in diving speed, high-altitude performance, and maximum speed, all of which had been knowingly given up in exchange for maneuverability and range, given the available engines.

The important historical, tactical lesson was that the Zero was so good at what it did that it forced the United States to change its fighting doctrine. Prewar combat doctrine in the United States and elsewhere was predicated on dogfighting techniques. The engineers' designs and the crews' training implemented this doctrine. As a substitute, American pilots had to learn to attack first, to fly in protective pairs, to break off a dogfight, and to use altitude for diving hit-and-run attacks.

Although the Zero remained the most maneuverable aircraft until the end of the war, the lack of skilled pilots became a serious liability as flying skills and astute use of tactics deteriorated. Against the later American fighters, tactics and training finally combined with technology to spell the end of dominance of the Zero fighter.

### III. Since 1945: The Loss of Tactical-Technical Competence

Since 1945, the conditions favorable to tactical-technical innovation, not to speak of revolution, have virtually disappeared from Japan. Resources (as a share of the economy) declined sharply from the levels of the earlier 75 years; national focus, intellectual attention, and feedback fell to insignificance. Despite the preservation of a rump military-industrial complex and its attendant government bureaucracy left over from the wartime period, their ability to conceive of and design advanced systems and concepts is severely compromised by the environment in which they are embedded.

**Containing a Rump Military-Industrial Complex.** The first priority of the American Occupation authorities in Japan was demilitarization. Post-surrender policy directed that “the existing economic basis of Japan’s military base must be destroyed and not permitted to revive.”<sup>47</sup> To implement this policy, the Occupation authorities began to dissolve the *zaibatsu* and dismantle military plants. However, because of the 75 years of unbalanced development, something like three-quarters of Japan’s industry was related to military output.<sup>48</sup> Furthermore, many of the same people remained in the same positions of authority in industry and government as before. Others left the arsenals and military laboratories to take up key positions in industry. With a weak state and disorganized economy in the wake of widespread destruction and reorientation, many of these people sought a return to the familiar and profitable days of military production.

After only a few years of strict demilitarization, the United States revised its policy toward Japan as part of its broader anticommunist containment strategy. Under the new Asian security policy, Japan would be the United States’ unsinkable aircraft carrier in the Pacific. In 1948, George Kennan, the architect of Soviet containment, advocated the revitalization of the Japanese armaments industry. The dissolution of the *zaibatsu* and the dismantling of arms factories were suspended. By late 1950, within months after the beginning of war in Korea, the United States was seeking ways to incorporate Japanese military production into the war effort. Secretary of State John Foster Dulles and his aides met with representatives of Japanese industry to discuss “economic cooperation” — a code for arms production.

The Japanese business leaders involved in these discussions organized a formal group — the Defense Production Committee — within the leading business organization, *Keidanren* (Federation of Economic Organizations), to coordinate their views and develop policy. This Defense Production Committee mainly included members of the old military-industrial complex; it has almost always been chaired by Mitsubishi Heavy Industries — the largest military company in Japan.<sup>49</sup> The executive director, Tetsuya Senga, who would continue to occupy the job for thirty years, had been a wartime official of the Imperial Army’s

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<sup>47</sup> Quoted in Samuels, *Rich Nation, Strong Army*, p. 131. Much of this section is based on Samuels’ chapter 5, pp. 130-148.

<sup>48</sup> Japan was not unique in this respect; because of its pursuit of similar goals, the Soviet Union’s economy was even more unbalanced than Japan’s, having emphasized heavy industry to the exclusion of other sectors.

<sup>49</sup> The original name of this committee was the U.S.-Japan Economic Cooperation Discussion Group.

organization that coordinated military industry. In later years, he was often called the unofficial “minister of defense.”<sup>50</sup> This unofficial title carries a subtle message; the highest defense official, the director general of the Japan Defense Agency, has a rank below full ministerial level and the agency itself is described as a “secondary state agency.” The first policy paper of the committee indicated that “the business community would build anything the United States was prepared to buy.”<sup>51</sup> By the end of 1949, many of Japan’s old war plants were producing and repairing military equipment for the United States; by 1954-55, between one-half and two-thirds of the orders of the Japanese machine industry were from the United States military.

The Ministry of International Trade and Industry (MITI) worked to promote an arms industry in order to develop an export base and improve domestic technology. It also wanted to keep the aircraft industry out of the hands of the Transportation and Communications Ministry and military production out of the military bureaucracy. It encouraged passage of the Aircraft Industry Law in July 1952 placing oversight of aircraft and arms in its Aircraft and Ordnance Division. This 1952 division was a direct descendant of the wartime General Directorate for Aircraft and Weapons of the Munitions Ministry.

The restart of the arms industry came about before Japan even had a military and before receiving formal permission from the Occupation authorities. The Defense Agency was not established until July 1952. Permission for resuming work on armaments had strong support from the American government and was granted in March 1952, but the whole issue of arms production was tied up with the delicate and emotional question of domestic rearming and the creation of a new Japanese military. Industry organized politically to promote rearming, treading softly on the military security aspects of the policy while stressing asserted technological benefits to the nation as a whole. This approach to selling the concept of an arms industry would be followed for the next 40 years.

Despite the enthusiastic support for a vigorous arms industry in certain parts of the business community and MITI, opinion was far from uniform on the matter. Prime Minister Shigeru Yoshida feared that a revived arms industry would lead to politically divisive calls to rebuild the armed forces, even if Japan’s arms were being sold only to the United States or other export markets. Outside of military industry circles, opinion was growing among business and banking leaders that though American arms procurement in the short run and Japanese military demand over the longer run may be desirable temporary expedients to support the economy during recessions, commercial exports and nonmilitary domestic demand were preferable. The financial sector argued that arms production was not only too risky to warrant financial support, but that it would divert resources from users with greater growth prospects. The Ministry of Finance feared a return to wartime fiscal deficits if rearming were to transpire. Even in MITI, officials in other divisions questioned the growth-enhancing role of military industry in particular and heavy industry more generally. This view reflected a split in the economy along light and heavy industry lines; the former was so reluctant to embrace rearmament that the director of the Defense Production Committee would later say that “light industry was the real enemy of defense production.”<sup>52</sup>

<sup>50</sup> Chinworth, Michael, *Inside Japan's Defense*, Brassey's (US), Washington, 1992, p. 2.

<sup>51</sup> Samuels, “*Rich Nation, Strong Army*”, p. 136.

<sup>52</sup> Quoted by Samuels, “*Rich Nation, Strong Army*”, p. 146.

was joined by a powerful member Minoru Genda in 1962, who usually chaired the group through the 1960s and 1970s. Genda had been Admiral Isoroku Yamamoto's principal planning officer in the Pacific War and planned the navy's Pearl Harbor attack. After the war, he served as chief-of-staff of the Air Self Defense Forces before retiring and running for the Diet.<sup>56</sup>

The LDP's Defense Division strengthened its ties to industry by establishing a joint committee with Keidanren's Defense Production Committee in 1961. Self Defense Force members who retired to run for Diet seats often received financial support from Mitsubishi Heavy Industries and other defense companies. However, the Defense Division was not able to control the LDP's defense policy; one reason for the weakness of the defense industry supporters is that Prime Minister Ikeda in 1961 created a security commission in the party with a broader mandate that was explicitly designed to contain the influence of the Defense Division.

After the Lockheed scandals of the 1960s and 1970s, the links between the LDP and the Defense Production Committee were severed and the LDP's Defense Division was discouraged from taking positions on specific procurements. Other Diet members seeking military industry support created the League for the Enhancement of Autonomous Production in 1982. The League fell into dormancy a few years after its creation. In his review of the military industry lobby in the Diet, Michael Green of Johns Hopkins University comes to the conclusion that ultimately the defense group's capabilities for political financing fell short of many Diet members' expectations.<sup>57</sup>

It was not until the 1980s that defense spending on procurement reached sufficiently high levels that enough Diet members could be attracted to a *zoku*, or "policy tribe" on defense. Until the size of the budget generated interest, meetings of the Defense Division drew only four or five members compared to the 60 or 70 who attended in the mid-1980s.<sup>58</sup> With the end of the Cold War, however, the defense group lost momentum. Finally, the Recruit scandal in 1989 knocked the chairman of the LDP defense advisory group out of office and in the 1990 elections five of the principal members were defeated or retired. Many politicians took the devastation of the defense politicians in the 1990 elections as a signal from the voters that the advantages of associating with defense issues were outweighed by the postwar antipathy to the military. LDP leaders set up several commissions to review Japan's defense in the post-cold war era and in light of the country's fumbling response to the Gulf War. However, before conclusions could be drawn, the LDP itself lost power in 1993 to a coalition that was demonstrably more cool to the military than the LDP. As Japan goes through a political restructuring in the 1990s, the military is unlikely to gain even the limited favor it had gained during the 37-year rule of the LDP.

**Defense Policy.** Japanese defense policy since the country came out from under the U.S. Occupation in 1952 has not underwritten a large military industry. To achieve its top priority goals of economic reconstruction, international rehabilitation, and security, Japanese leaders adopted a two-pronged strategy.

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<sup>56</sup> Green, Michael, *Boeizoku: Defense Policy Formation in Japan's Liberal Democratic Party*, Massachusetts Institute of Technology, MIT Japan Program, 92-104, Cambridge, 1992, p. 14.

<sup>57</sup> Green, *Boeizoku*, p. 21.

<sup>58</sup> Green, *Boeizoku*, p. 13.

First, they would concentrate on expanding foreign markets while nurturing domestic industry. Trade was especially important for economic growth because of Japan's dependence on foreign inputs for its industry; to pay for the imports, Japan had to export. Second, Japan would minimize military expenditures and maintain a low international profile, relying on the United States to guarantee its security. The architect of this strategy, the first postwar prime minister Shigeru Yoshida, was reluctant to participate in a multilateral Pacific security pact that would draw Japan into cold war politics and dangers, force Japan to devote resources to remilitarization, risk enmity from its neighbors, and delay economic recovery. This basic policy governed most of Japan's security policy for the next 40 years.

Efforts by several political leaders to alter the Yoshida doctrine were unsuccessful because, according to former Prime Minister Yasuhiro Nakasone, "public opinion had become blindly committed to pacifism as the best way to preserve their livelihood."<sup>59</sup> Mr. Nakasone called for strong political leadership to wean the Japanese people from the politics of "willful political innocence, . . . prevarication, escapism, and ostrich-like pacifism." When governments tried to implement policies for a more activist Japanese international role, however, they were attacked by all sides: by the bureaucracy for overriding its prerogatives and narrow policies; by conservatives who clung to the Yoshida doctrine; by the left, which saw the constitution being undermined; and by hard-line nationalists, who regarded the government's plans as too deferential to the United States.

Consistent with this basic thrust were two cabinet decisions that codified the Yoshida policy. Although each was conditioned by contemporary politics, they flowed from the self-reinforcing cumulation of an essentially pacifist security policy. The first of these decisions was taken in 1967 when the cabinet of Prime Minister Eisaku Sato reinterpreted the Export Control Ordinance of 1949 in strict terms, proscribing arms sales to communist countries, countries at war, and those apt to engage in international conflict. The Defense Production Committee tried to weaken the definition of arms to include only things that kill or destroy. However, neither the public nor the government agreed. Industry repeatedly tested the three arms export principles, but the government firmly resisted these initiatives. In February 1976, the Miki government announced an extension of the export ban to production equipment, making the policy clearer and tighter than ever; it defined "arms" as "what military forces use for combating."<sup>60</sup> This policy would only be relaxed in a cabinet decision of January 1983 allowing military technology transfers to the United States.

The second decision strengthening the course of Japan's military policy was the October 1976 capping of defense spending to one percent of GNP. This limit was imposed as part of the 1976 National Defense Program Outline, or *Taiko*. This comprehensive document replaced a series of ad hoc, short term programs that had governed force posture and spending since 1957. It provided a general explanation of Japan's security policy, reconfirming defensive defense — repelling limited conventional attacks while relying on the United States and its nuclear umbrella for broader strategic protection. The *Taiko* also set out desired force level goals. The one-percent cap was intended to promote public acceptance of the overall

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<sup>59</sup> Nakasone's quotations are taken from: Pyle, Kenneth, "Japan and the Future of Collective Security," in Daniel Unger and Paul Blackburn, eds., *Japan's Emerging Global Role*, Lynne Rienner Publisher, Boulder, 1993.

<sup>60</sup> Japan Defense Agency, *Defense of Japan: 1993*, Japan Times, 1993, Reference 16, p. 251.

policy by quieting public anxieties over the seemingly uncontrolled growth of military spending. The Miki cabinet thus used the *Taiko* and the cap to avert political controversy while placing defense on a more solid, though restrained, foundation.

The non-export policy and the spending limits were among the most important limiting influences on Japanese military-technical experience in the postwar period. The other major constraint, to be discussed in more detail below, was the non-military quality of the Self Defense Forces.

**Significance of Low Spending.** The effect of the spending cap on defense budgets has bounded Japan's resource allocations to the military. Growth of the defense budget traced economic growth. Despite a 30-year average annual real growth rate of 5.7 percent, Japan's defense budget in 1990 was only one-seventh that of the United States.<sup>61</sup> (The United States GNP was roughly 2.5 times greater than Japan's.) United States defense R&D in 1990 was 70 times greater than Japan's, partly because R&D took a bigger chunk out of United States spending: 12 percent of the total defense budget versus 2.2 percent in Japan. Since a significant amount of Japanese defense R&D in the past was financed by the private sector with recoupment later in the procurement phase, the sum of R&D plus acquisition gives a better picture of Japanese spending on these combined accounts. R&D plus acquisition in the United States was close to 40 percent of the total defense budget in 1990 compared to the Japanese figure of 29 percent. Therefore, the impact of defense on the economy is about ten times greater in the United States than in Japan, with ratios of procurement to manufacturing value added of 8.8 percent and 0.9 percent respectively.

Dollar or yen budget comparisons do not tell the full story. Current official Japanese spending figures overstate force posture implications for several reasons. First, because growth has been so rapid over an extended period, today's spending is considerably larger than in the past. Therefore, the cumulative value of investments in equipment, technology, and personnel are much smaller than suggested by current figures. To a rough approximation, a country with a long-run, stable budget only half Japan's could possess the same stock of investment. Second, Japanese equipment is often overpriced; the Japan Defense Agency uses a rule-of-thumb for planning purposes that assigns domestically produced systems a cost that is three times their price on world markets. Even adjusting for small quantities, Japanese tanks (for example) are still twice the cost of American tanks. Since 1985, exchange rates attribute a much higher value to the yen than is reflected in actual prices. Unless spending figures in yen are converted by a rate that reflects real market prices, Japanese expenditures can appear too high by 30 to 80 percent, with the discrepancy greater for the more recent years.

Keeping these considerations in mind, the International Institute for Strategic Studies estimates that four of the 15 NATO countries (U.S., Great Britain, Germany, and France) outspent Japan in 1990.<sup>62</sup> In per capita terms all NATO members except Portugal, Spain, and Turkey had higher expenditures. Among the European neutrals, per capita defense expenditures in Austria of \$100 fell below Japan's figure of \$132, while Sweden at \$350 and Switzerland at \$315 were some two-and-a-half times greater.

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<sup>61</sup> For 1990 comparisons, an OECD purchasing power parity figure of 196 ¥/\$ was used to convert Japanese yen figures to dollars.

<sup>62</sup> International Institute of Strategic Studies, *The Military Balance: 1993-94*, London, Brassey's, pp. 224-228.

**Defense-Industrial Implications of Japan's Defense Budgets.** The most salient consequence of Japan's postwar defense spending patterns is a low level of experience in the design and production of military systems. Except in a few chosen weapons types — mainly aircraft, tactical missiles, armored vehicles, and ships — Japanese producers have relatively little experience with military products.<sup>63</sup> For example, the 1988 edition of *Janes' Weapons Systems* lists military equipment by category and country of production; counts of items produced in Italy, Israel, and Japan reveal significant differences between the countries. Japan produced far fewer categories of military equipment than the other two countries, and for each category in which it made a showing, Japan produced fewer different types and models. Israel produced items in 21 of the listed categories, with more than five models on the average in each; Italy produced an average of eight models in each of its 23 categories. Japan, in contrast, engaged in only 12 categories, each with an average of three models. Significantly, Israel's GNP is but 2.2 percent of Japan's while its defense budget is 38 percent as large; the respective figures for Italy are 40 percent for GNP and 74 percent for defense. In both breadth and depth, Japanese defense industry has considerably less experience than other countries that are less constrained by budget and policy in military activities.

A closer look at several major weapons systems reveals Japanese industry's strengths and weaknesses. The aircraft industry has been a focus of MITI's attention since the early 1950s for industrial policy reasons. Indigenous production of Japan's weapons systems, or *kokusanka*, has governed many selection decisions. Japan has produced at home all of its fighter aircraft from the F-86F in 1956 to the current production run of the F-15J. All except the domestically designed F-1 were licensed American models. The gain in production experience in the past 35 years has been substantial, especially considering that Japanese industry's technological capabilities in aircraft had been halted for close to a decade. The only locally produced subsystem of the first postwar fighter was the licensed airframe; the engine and armaments were purchased from American suppliers. Twenty-five years later, companies in Japan produced the airframe, engine, radar, and missile of the F-15 within six years of first production in the United States.

Domestic development, though, did not make similar progress. The F-1, derived from the T-2 trainer, was not a high-performance aircraft and 42 percent of its parts were said to have been produced under foreign license. No engine or radar for fighter aircraft has been developed in Japan. In a sharp break with the past, though, the radar on the FSX now under development is an indigenous design.

As with aircraft, missiles have been given special attention by MITI. In September 1953, the *Keidanren* Defense Production Committee organized a guided missile discussion group of 14 firms and representatives from the major industry associations and MITI. A year later, only months after the establishment of the Japan Defense Agency, the Defense Production Committee recommended domestic missile R&D to develop missiles for "those conditions peculiar to Japan."<sup>64</sup> The report urged collaborative

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<sup>63</sup> These points are discussed more fully in: Alexander, Arthur J., *Of Tanks and Toyotas: An Assessment of Japan's Defense Industry*, N-3542-AF, The Rand Corporation, Santa Monica, CA, 1993, pp. 37-50.

<sup>64</sup> Those "peculiar conditions" were most likely the profits and technology base of the participating companies. A description of the missile policy is in Samuels, "Rich Nation, Strong Army", pp. 144, 157-158.

research to catch up with the United States without “excessive competition” among the companies. Soon after this report, the JDA initiated a guided missile program with the stated rationale that “national defense without dependence on foreign powers cannot be accomplished without guided weapons.”<sup>65</sup> The first domestic missile program was an antitank system started in 1957.

The first indigenous design for an air-to-air missile began around 1960. Development of the heat-seeking AAM-1 proceeded slowly because of low funding rates and little experience. In the meantime, the JDA purchased the U.S. AIM-9B Sidewinder in the early 1960s and the Hughes Aircraft AIM-4D Falcon radar-guided missile at the end of the decade. The domestic AAM-1 entered production in 1969, but the program ended three years later with production of only 400 units. The AAM-1 was similar to the American Sidewinders produced a decade earlier and it cost more than three times as much. The AAM-2 program was then initiated, but was canceled in favor of a license-built AIM-9L, which had better performance and was available considerably earlier than the indigenous system. The follow-on AAM-3 research program started in 1974; low-rate production got under way in 1993. Other air-to-air missile programs have included the licensing of the AIM-7 Sparrow radar-guided system and an indigenous radar-guided R&D projects.

Insufficient funding was responsible for the schedule delays and cancellations of several Japanese missile projects. One reason that the AAM-3 took almost 20 years to enter production was that the government budgeted the equivalent of only \$65 million on R&D, compared to the almost \$1 billion the United States spent on the AIM-9. Of course, Japanese companies likely put their own money into the project, but it could not have been enough to fully fund the project. A similar story could be told about the ground attack ASM-1 missile developed for the indigenous F-1 aircraft. Only about 100 have been produced since 1980. Since 1960, Japanese domestic designs have accounted for roughly 500 airborne missiles. Purchase of American-produced models accounted for more than 3,000, and Japanese production of licensed American models numbered about 5,000.

Because of the relatively small scale of Japanese defense procurements, the leading firms in Japan do not rank high in a worldwide comparison. Table 1 shows comparative information for the leading Japanese and American defense firms for 1993.<sup>66</sup> Contracts have been increasingly concentrated among the top firms, with the largest four or five receiving half of all procurement money. It is revealing to note that these same companies were also the leading *zaibatsu* firms 50 years ago. The top Japanese contractor, Mitsubishi Heavy Industries, was number 21 in the global league in 1993. The four largest military industry firms in the world were all American. Most of the large Japanese defense contractors are highly diversified across military products and across the military-civilian divide. The top ten companies had ratios of defense sales to total sales under 30 percent. This level of diversification stands in sharp contrast to the U.S. industry, which has become quite specialized in the past fifty years of hot and cold war and large defense budgets. Even at the lower ranks of American defense companies specialization prevailed in

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<sup>65</sup> Quoted in Samuels, *Rich Nation, Strong Army*, p. 157.

<sup>66</sup> *Defense News*, “Defense News Top 100,” July 18-24, 1994. The proportion of defense sales of Japanese companies is taken from the *Defense News* table. These data are not fully consistent with figures reported by the Japanese companies, although they agree to within a few percentage points.

the late 1980s; of the 300 largest contractors, the median ratio of defense to total sales was 80 percent.<sup>67</sup>

Table 1: Characteristics of Japanese and U.S. Defense Firms, 1993

<u>Company</u>	<u>Rank in Japan</u>	<u>Rank in World</u>	<u>Defense/Total Revenues (%)</u>	<u>Defense Revenues (Millions \$)</u>
<b>Japan</b>				
Mitsubishi Heavy Industries	1	21	10	2,372
Kawasaki Heavy Industries	2	38	13	1,120
Ishikawajima-Harima Heavy Industries	3	47	11	840
Mitsubishi Electric Co. (Melco)	4	49	3	820
Itochu	5	69	0.3	475
Nippon Electric Co. (NEC)	6	79	1	390
Toshiba	7	86	1	353
Mitsui Engineering & Shipbuilding	8	92	10	306
Fuji Heavy Industries	9	100	3	276
<b>United States</b>				
Lockheed Corp.		1	78	10,195
McDonnell Douglas		2	63	9,052
GM Hughes Electronics		3	49	6,600
Martin Marietta		4	67	6,320
Raytheon		6	51	4,700
Northrop		7	90	4,532
Boeing		8	17	4,407
United Technologies		10	19	4,000

Source: *Defense News*, July 18-24, 1994

Japanese military procurement and R&D projects have to be carefully attuned to the total sums that planners have to work with. Major systems would break the bank. According to costs (in constant 1985 prices) provided to Congress, the F-18 aircraft development required about \$3.7 billion (without engine); the F-100 engine in the F-15 and F-16 aircraft cost \$2.7 billion; the CH-47 Chinook helicopter required about \$340 million for the first model and \$100 million for the engine; subsequent models of the CH-47 required an additional \$550 million, plus \$250 million for the engine. The AMRAAM radar-guided missile development cost the U.S. government at least \$1 billion and the M-1 Abrams tank about \$900 million. Air-to-air missile upgrades come a little cheaper; development costs to upgrade from the previous model were \$73 million for the AIM-7M (Sparrow III), \$36 million for the AIM-9M, and \$200 million for the AIM-54C (Phoenix) carried on the F-14. Japanese R&D plus procurement budgets of \$6-7 billion annually simply cannot afford this kind of systems technology and experience.

A study of Japan's defense budget and its sub-accounts over a 30-year period arrives at similar

<sup>67</sup> This sample of companies was comprised of stand-alone defense companies and the defense subsidiaries of diversified parent firms. For example, I.B.M. Federal Systems was included in the sample but not the parent I.B.M. Corporation. Alexander, Arthur J., Paul T. Hill, and Susan Bodilly, *The Defense Department's Support of Industry's Independent Research and Development (IR&D)*, R-3649-ACQ, The Rand Corporation, Santa Monica, CA, April 1989, Table A3.

conclusions to the above description. This study finds that in explaining the defense budget, “substantive military purpose seems to be of little importance, compared to macroeconomic policy and a broader conception of national security.”<sup>68</sup> The statistical analysis is consistent with a process whereby the Defense Agency and Ministry of Finance fit programs into the budget as funds permit; programs are not the drivers, singly or in the aggregate.

A natural question to this recitation of American weapons costs is whether Japan would have to spend this kind of money to gain tactical-technical sophistication. Japanese military system R&D could be considerably more efficient than American efforts; the United States puts a great deal of attention and resources into reliability and performance under diverse global conditions, about which Japanese designers do not have to be concerned. Also, commercial R&D in Japan has demonstrated efficiencies that companies in the United States are now emulating. However, the development of complex military systems may be less amenable to the same kind of cost-cutting practices shown in civilian products. For example, Israel has often developed innovative military systems at startling low costs. However, its Arrow anti-missile program, financed with American help, is a high-priced effort with combined Israeli and American financial commitments of almost \$1 billion. These expenditures have not yet yielded a system close to production.<sup>69</sup>

Japanese military R&D planners are looking at major projects costing about 100 billion yen, or roughly \$500 million at purchasing power parity. R&D budgets would have to increase significantly beyond current levels to incorporate many (or any) major systems.

**The Central Problem: Insufficient Feedback.** Discussions with experienced military analysts, interviews in Japan, observation of operations and training, and analysis of the origins of several Japanese systems all suggest that the Self Defense Forces are relatively unsophisticated buyers of new weapons. More precisely, the requirements setting process in which specifications are established for equipment to perform operational missions as part of a complex array of other systems, all within cost constraints, is an art that is not well developed in Japan. The sum of knowledge and experience, of technology and of warfare, that allowed Jiro Horikoshi to trade off structural strength for range in the Zero fighter and that enabled the Imperial Japanese Navy to accept the limitations imposed by that choice is missing in today’s Self Defense Forces and military industry.

Inadequate spending is not the central problem of Japanese tactical-technical shortfalls, although it is certainly a major contributor. Israel has a smaller budget — less than 40 percent of Japan’s — yet its indigenously designed systems and tactical innovations are widely studied as precursors of future warfare. The difference is in focus and feedback. Israel, even more than the United States, pays exquisite attention to military affairs. It has engaged in several wars that threatened the existence of the state since its creation in 1947. It trains realistically. The feedback from warfare, training, and sales of some of its systems to other countries informs a civilian and military intelligentsia dedicated to fighting better. Much the same

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<sup>68</sup> Bobrow, Davis B. and Stephen R. Hill, “The Determinants of Military Budgets: The Japanese Case,” *Conflict Management and Peace Science*, Fall 1985, p. 15.

<sup>69</sup> Opall, Barbara, “Arrow Again Wins U.S. Funds,” *Defense News*, November 21-27, 1994.

evaluation could be made of the United States with its more than half century of hot and cold war, its arms exports and supply of allies, its alliance relationships, and its think tanks and doctorate programs dedicated to thinking about war. However, since the sheer size of the United States can distort and confuse analysis, the example of Israel may be more informative. Indeed, Japan of the 1930s is an equally valid alternative case study.

Today's Japanese military is without combat experience. It plans and trains in a benign environment. Japanese political and social norms restrict operations. For example, low-level combat training flights by Air Self Defense Force pilots run into objections from several fronts: noise levels are unacceptable; the possibility of crashes severely limits the areas suitable for flying; and the politically sensitive question of just who the presumed enemy might be is perhaps the most severe bar to realism. *It is not too much to say that if Japan wants to have a military, it cannot act in a military way.* This is the paradox of an essentially pacifist political culture that nevertheless has real security interests.

Japanese operational competence, however, has been enhanced in two areas where the SDF has come face to face with real threats. Air intercepts of Soviet bombers were accomplished with professionalism, according to U.S. Air Force officers working in close collaboration with their Japanese counterparts. Anti-submarine warfare against intruding Soviet vessels also received similarly high commendations, although problems in collaboration across services were reminiscent of the divisions in the old imperial military institutions.

The services do not have the support of specialized technical organizations to assist in setting requirements and in program management. The small staff of the Technical Research and Development Institute does not compare with the many American military service laboratories such as the U.S. Air Force Avionics Laboratory or Materials Laboratory. There is no organization like the U.S. Army's Training and Doctrine Command that acts as a laboratory for warfare, a combat development command.

The experience of military industry, likewise, is severely limited. Successful weapons design and development requires the military-operational knowledge of how weapons are used, maintained, and supplied. The Soviet Union, for example, designed equipment for short combat lifetimes but high reliability during the period of active combat. Most maintenance took place in depots by experienced mechanics. The United States, in contrast, designed to minimize life-cycle costs over a long life spent mainly in peacetime training. Skilled professional front line and second echelon soldiers had a larger maintenance responsibility than their Soviet counterparts. Equipment design in both countries reflected an intimate knowledge of how equipment was intended to be used.

Competent design also depends on the knowledge of how to organize and assemble an array of subsystems into a system, and how to combine these pieces into a mission-capable set. Thus, a typical air-defense system includes the surface-to-air missiles, launching equipment, transporters, radars, power supplies, fire control computers, and crew stations. System architecture choices and design tradeoffs have to be made within each element of this "weapon", across elements, and over other types of systems. For example, advanced warning can come from AWACS aircraft, picket ships, ground-based sensors, or

satellites, each with different reaction times and locating abilities. The SAMS have to be coordinated with friendly aircraft. Design interfaces have to link many kinds of systems across military services. It is this kind of integration experience most lacking in Japanese military industry and most important for considering military-technical revolutions.

**The Effect of Military-Industrial Policy.** One source of the problem of inadequate requirements in Japan is that many choices for the development and production of military systems were driven by industrial policy concerns rather than military values. The overall approach to this subject was usually subsumed under the heading of autonomous weapons production or autarky (*kokusanka*: national production, in Japanese). The oldest rationale for autarky is the alleged unique design, tactical, and operational requirements of the Japanese forces. These arguments often range from the silly to the laughable, but are so commonly and seriously extended as to assume the quality of “common sense”. They include the asserted smaller size and different internal physiology of the Japanese soldier, the width of Japanese roads, and the expanse of ocean to patrol. Logistics is the basis for a second autarky argument. Equipment produced domestically shortens logistics chains and helps assure the timely provision of parts and maintenance.

Strengthening civilian technology is the chief argument for *kokusanka* used by industry, although the use of this argument has declined in recent years. Defense autarky is good for the economy — and for the contractors. MITI pushed the development of the T-1 and T-2 training aircraft to give industry its first postwar experience with systems integration even though the Air Self Defense Forces had trainer versions of the F-86 and F-104 to work with. ASDF pilots said that the T-2 aircraft was “a trainer for industry, not pilots.”<sup>70</sup> Spin-off to the civilian economy is given a national complexion, but in order to support this argument, both MITI and industry had to demonstrate the diffusion of the military-generated technology. One of the first stories anyone looking into this subject will hear is about the application of F-86 technology to the brakes of the famed Japanese bullet trains. Government and industry have elaborated a number of rhetorical devices to promote these arguments. “Technology is not military or civilian, black or white, but different shades of gray.” In one flourish, technology is pictured as a tree with deep and widespread roots producing many fruits. This rationale is also consistent with spin-on. If military production takes place domestically, the nation’s civilian technology can be applied to it, thereby obtaining double benefits from the original investments and achieving economies of scale; these advantages would be lost if equipment had to be acquired offshore.

An underlying theme supporting autarky is the potential vulnerability inherent in foreign supply. Technonationalism in weapons production is a common national policy as most countries fear dependency and its dangers. Japan has had the postwar experience of being denied the sale and license of the most advanced U.S. equipment and access to “black boxes” for domestic maintenance and upgrades. In 1941, it was the embargo on oil and steel that was the final step on Japan’s path to war. Despite these concerns, the country has not pursued other policies to diminish vulnerability such as diversifying suppliers and stockpiling materiel. The contrast with Japanese energy policy is striking; in dealing with its great foreign

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<sup>70</sup> Green, Michael, *Kokusanka: FSX and Japan’s Search for Autonomous Defense Production*, MIT Japan Program, MITJP 90-09, Cambridge, 1990, p. 5.

dependence in that sector, the nation addressed the matter through all the available means: diplomacy, promotion of conservation and substitution, diversification of types of energy, diversity of supplier countries and regions, development of domestic nuclear power, and subsidy of Japanese coal suppliers (although this last policy had more to do with local politics than energy security).

A final argument heard for autarky is that having domestic technological competence places Japan in a better bargaining position vis a vis the United States over access to advanced American systems. The underlying presumption is that if the United States does not provide the desired item, then Japan has the capability to produce it on its own and deprive American companies of the sale and the other benefits of systems commonality.

Arguments against autarky include: the high costs of domestic sourcing; reduced levels of military performance because of inferior domestic military technology and experience; possible loss of commonality with U.S. forces, negatively affecting logistics, training, and operations; and the economic and foreign policy effects of not buying American products, especially in the period since Japan has had a large trade surplus with the United States.

MITI and the major firms concentrated their promotional efforts on fighter aircraft and tactical missiles, apparently under the assumption that nurturing competence in these products would have the biggest payoff in achieving the various goals of autonomous production. Other major platforms such as ships and armored vehicles also benefited from this policy; since the early 1960s, all new armored vehicles and naval hulls have been produced in Japan.

The objective of Japanese aircraft policy was the production of complete systems rather than subsystems or upgrades; on the civilian side, this position was modified in the 1970s to emphasize collaboration with foreign companies. Again, this approach seems to be based on the belief that this was the path to the technological and industrial big leagues. As far as we can determine, no analysis or evidence was produced to justify these choices, but was part of the assemblage of things that "everybody knows." The contrast with Israel is striking. Israel felt the penalties of vulnerability keenly when France embargoed a shipment of Mirage fighter aircraft and missile patrol boats. Israeli policymakers responded first by stealing the boats and the plans to the aircraft, and then by diversifying its suppliers. It also developed an aircraft industry to upgrade and improve its purchased aircraft to meet the tactical conditions faced by the Israeli air force. It added many of its own devices, bought others from suppliers around the world, and removed subsystems that were included in the American versions of the aircraft but were not needed by Israel. Although Israel also tried to build its own fighter for many of the same reasons motivating Japan (chiefly national technological hubris), it was abandoned because of its prohibitive cost. Israel's domestic electronics industry became a world leader in electronic warfare, its aircraft industry produced a range of unmanned vehicles for intelligence and reconnaissance purposes, and its shipbuilders turned out small attack vessels equipped with Israeli missiles. Although some of these military items are being sold abroad, the principal market has always been the Israeli defense forces. Profitable spinoffs include an image processing system developed for intelligence purposes that is now the world publishing standard.

A review of the postwar history of Japanese military industry conduct suggests that it had much more to do with the identity of the players than with any explicit policy — military or commercial. That the key companies had their roots in 75 years of arms production with an emphasis on aircraft, ships, and armored vehicles and that the postwar government personnel overseeing the industry were participants in the same historical drama seem to be a better explanation of the current state of Japanese military industry than either explicit or unstated rationales. Simply put, there are grounds for arguing that postwar Japanese military-industrial policy advanced both military objectives and economic goals worse than plausible alternative policies might have done. The choices were compounded from fable, psychology, personal and organizational history, mimicry, and politics; it was a melange of myth and money in a military stew.

#### IV. Impressions of the Current Situation

**Pacifist Societal Norms.** A distinguished Japanese historian, Saburo Ienaga, has contrasted postwar to prewar Japan: "In the period before August 1945, Japan was a 'warfare state.' Bristling with armaments and dominated by a professional military caste, the nation waged war against its neighbors. ... Defeat in World War II transformed Japan into a 'peace state.'"71 Professor Ienaga suggests, however, that popular consciousness was not transformed overnight because neither the surrender nor the new "peace" constitution had been accomplished through popular struggle. A question for us is the depth or staying power of Japan's pacifist social norms today.

Political scientists assert that "an anti-militarist public opinion continues to mark debates on military issues."72 Katzenstein and Okawara argue that institutional structures bias policy strongly against forceful articulation of military security objectives and give preference to a so-called comprehensive definition of national security that emphasizes the economic and political dimensions.73 The main institutional feature that contributes to the diminished role of military security is the low-status of the Japan Defense Agency. Many of the JDA's key officials are appointed by other ministries and its policy scope is bounded by the assignment of nominally military issues to other ministries. A civilian bureaucracy "that lacks all military ethos and perspective" supervises the professional military. This arrangement is endorsed by Japan's political and economic elite, "which retains a profound distrust of the professional military."74

This same theme is taken up by Thomas Berger who also highlights Japan's postwar culture of anti-militarism with roots in "memories of the military takeover in the 1930s and the disastrous decision to go to war with America."75 According to Berger, the chief lesson Japan drew from its wartime experience is that the military is a dangerous institution that must be constantly restrained and monitored lest it threaten the postwar political and economic order.

**Popular Military Literature.** Being aware of these arguments, we were surprised to observe two recent phenomena that appeared to contradict the pacifist ideal. In a sharp break with the past, scores of war novels in Japanese bookstores picture the Imperial Japanese Army and Navy as invincible forces beating the United States.76 These works are cast as "simulations" that investigate what might have happened if Japan and the military had chosen different policies. Some of these novels update the scenarios with the Self Defense Forces fighting simulated battles. One publisher has sold 5 million copies of this genre and another sold 4 million copies of 60 titles.

The second challenge to our notions of pacifism is the appearance of military comics (*manga*) in which

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71 Ienaga, Saburo, "The Glorification of War in Japanese Education," *International Security*, Winter 1993-94, pp. 115-116.

72 Katzenstein, Peter J., and Nobuo Okawara, "Japan's National Security," *International Security*, Spring 1993, p. 87.

73 Katzenstein and Okawara, "Japan's National Security," p. 92.

74 Katzenstein and Okawara, "Japan's National Security," p. 96.

75 Berger, Thomas U., "From Sword to Chrysanthemum," *International Security*, Spring 1993, p. 119.

76 Yoshida, Reiji, "New War Novels Reshape History," *The Japan Times*, January 29, 1994.

Japanese forces are victorious. Comics are fantasies bought by a wide segment of the Japanese population, but oriented to non-elites; they have fewer constraints on their content than do more high-browed genres. Since *manga* comprise nearly one quarter of all published books and magazines published today in Japan, they are a particularly powerful spotlight on popular images. In an attempt to find out whether the imaginative popular arts may be saying something that is escaping scholars looking at elite sentiments, we commissioned a study by one of the leading analysts of Japanese popular culture to take a look at military *manga*.<sup>77</sup>

The American Occupation heavily censored comics to eliminate references to feudal and militaristic values. Samurai tales and judo stories disappeared from the pages, as did the editors from their former line of work. After the Occupation ended, martial arts and feudal themes reappeared, but these were naive tales directed to young readers. When war stories appeared in the late 1950s and early 1960s, they reflected the pacifist mood. Many of the stories had a strong anti-war theme. In a story based on his personal experience, Shigeru Mizuki, one of the most distinguished artists in this genre, depicted in "gruesome detail, and obvious anger, the way arrogant Japanese officers squandered the lives of their men." Leiji Matsumoto, popular in the United States for his science fiction animations "Space Cruiser Yamato" ("Star Blazers" in the United States) featured protagonists who were pathetic, rather than heroic. They exist on battlefields where the enemy is rarely visible, where food is short, and death is matter-of-fact. The machines of war, in contrast, are depicted in a realistic, romantic light. The heroic aspects of fighting and aggression in comics have tended to be confined to science fiction and robots. Frederik Schodt suggests that the "fantasy warrior-robot genre of *manga* and animation can be viewed as a metaphor for a wish-belief that superior Japanese advanced technology will save the nation against external threats and enemies."

The largest publisher of current military comics is tiny by *manga* standards. Its most popular line is *Combat* magazine; it is published monthly and sells for ¥620 (about \$6.20), nearly twice the price of regular monthlies. Circulation is nearly 100,000; the readers are mainly males, around 20 years old, and hard-core fans of guns, survival games, and weaponry and hardware. Many readers are members of the SDF. Stories fall into four main categories: Pacific War battles; Germany in World War 2; simulation stories; and near-future science fiction. Part of the popularity of the simulation books and comics is that it permits the showing of a victorious Japan, rather than painful stories of defeat.

The best known military war comic is "Silent Service." This story of a renegade Japanese submarine commander in a high-tech, American-designed vessel incorporating superior Japanese technology began in 1989 in the popular comic magazine *Morning*. Its claimed circulation of 1.3 million has a relatively high average age of around 30 and includes many women. The story, which now runs to over 6,000 pages collected in 21 volumes, portrays Commander Kaieda and his elite Japanese crew. On a test run, Kaieda and his crew mutiny against the joint United States-Japan exercise and challenge the United States fleet. It is gradually revealed that his real goal is world nuclear disarmament and the creation of a transnational military force to enforce world peace. In the meantime, he creates havoc among the world's military

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<sup>77</sup> Schodt, Frederik L., *A Report on Military Manga*, 1994. This section on *manga* is drawn from Schodt's analysis. All quotations are from that report.

establishments through his brilliant maneuvers. The *Silent Service* became a sensation soon after its publication. It was debated in the Diet, featured in the media, and won the top *manga* award in 1990. It had many fans in the SDF; some academics feared that the story pandered to young rightists, although there was no specific evidence for this. Schodt thinks that it is probably not accidental that this story reached high popularity at the peak of the economic bubble in Japan when many people saw Japan as leaping ahead of a United States in disarray.

Schodt concludes that military comics, including *Silent Service*, still operate under the pacifist norms of the past 50 years. "War is still bad, nationalism and patriotism are still somewhat suspect, and military forces should only be used in the context of self-defense. ... They pale in comparison with war comics of the United States."

**Impressions from Interviews.** We have conducted interviews, discussions, and seminars over the past year with the major Japanese defense and electronics companies, with American defense companies in Japan, with Japanese government officials in MITI, the JDA, and Ministry of Foreign Affairs, with the leading defense industry associations, and with Japanese and American academics. Discussions about military technology were also held with American and Japanese military officers. Two strong impressions came out of these contacts. First, the pacifist sentiment in Japan was even stronger than we had imagined from our previous readings and experience. Second, tactical-technical innovation is weak and, as far as we could discover, almost nonexistent.

One example of pacifist sentiment was observed at a discussion arranged with the Defense Production Committee at *Keidanren*. Representatives of two of the major electronics companies not involved in defense work had been invited to attend. One of these individuals told us that he had only agreed to come after repeated urgings from the *Keidanren* staff; he personally felt a great deal of ambivalence at being in the midst of military industrialists. His company had a policy of not dealing directly with the military authorities, although it knew that its products appeared in military systems. The representative of the other electronics firm told us a similar story when we visited his company a few days later. Even high-ranking staff at the largest military-industrial companies described their careful attention to publicity surrounding their defense activities. Although they personally have few problems with the relationship, they fear the impact of adverse public opinion, especially since only a few percent of their sales and profits are from defense work. A project director of a major military electronics systems development effort said in exasperation that he wished Japan were a "normal country" so that he could take public pride in his work.

The weakness of military innovation was constantly proclaimed in conversations with firms and government people. When describing their strengths, the companies prided themselves on their production capabilities and on their skills at improving products. A senior technical manager at an electronics company with an American reputation for product innovation declared that Japan is a "production/improvement oriented society and the United States is invention oriented. Japanese companies are more like engineers aiming to meet users' demands." With respect to military users, he said that his company was not knowledgeable about defense applications.

Most of the companies we spoke to asserted that few new ideas came from the JDA. Equipment Bureau staff of the JDA agreed with these assertions. Our queries about possible innovations leading to drastically new ways of doing things drew a blank.

American defense companies operating in Japan have directed their staff to seek the best technology they can find in Japan for use in American military systems. Except for a few odds and ends, though, they found little of value. A survey by the M.I.T. Japan Program is consistent with our interviews.<sup>78</sup> More than 90 percent of the respondents (American defense industry respondents active in Japan) believed that they were ahead of Japan in the fields of technology most closely related to their own. No one indicated that Japanese companies were ahead. In explaining why they were in Japan, only one of the 23 respondents indicated that technology transfer from Japan was a major factor. According to an executive of an American company we interviewed, there were three possibilities for the low success rate of American defense companies in finding Japanese technology — civil or military: the American search may be ineffective; a “not invented here” psychology may blind American engineers to technologies developed outside their company; and there may not be much there that is worthwhile. This individual noted that his company was more successful in finding useful things in Singapore and Taiwan.

A parallel survey by M.I.T. of defense-oriented Japanese companies produced comparable results to the American survey.<sup>79</sup> Only 10 percent of the 50 Japanese defense companies responding to the survey assessed the level of their basic technology as being ahead of U.S. firms and laboratories in the same field. Six percent said they were ahead at the components level and a single firm believed it was ahead at the systems level. Looking ten years into the future, a more optimistic 28 percent thought they would be ahead of the United States in both components and basic technology. Fifty-six percent of the Japanese companies saw the main motivation of American companies in Japan to be the acquisition of Japanese technology for either military or commercial applications; this result differs from the survey of U.S. executives, who claimed little interest in Japanese technology.

Interviews with a retired Ground Self Defense Forces general now serving as adviser to a major defense electronics company were particularly informative. He said that a major problem is that Japan has no combat development command. The major defense companies, for example, have been asked by the JDA to look at future battlefield environments. Only five or six colonels are working within the military on this huge issue. The private companies’ strengths are in systems ideas, he said, not combat or tactics. There is no one to work on doctrine and no experience to integrate the total battlefield. Artillery, this retired general complained, can only work with its dedicated forward observers in a system dating back to the 1880s; they cannot receive information from other sources or sensors such as helicopters or laser designators. In one anecdote, he highlighted the importance of feedback from the field. The military is only now looking at the use of Global Positioning System (GPS) precision location satellites, although every electronics shop in Akihabara features consumer products with these capabilities. What drove the military was its

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<sup>78</sup> Rubiner, Matthew, *U.S. Industry and Government Views on Defense Technology Cooperation with Japan: Findings of the MIT Japan Program Survey, March 1994*, Massachusetts Institute of Technology, MIT Japan Program, MITJP 94-03, p. 13.

<sup>79</sup> Green, Michael, *The Japanese Defense Industry’s Views of U.S.-Japan Defense Technology Collaboration: Findings of the MIT Japan Program Survey*, Massachusetts Institute of Technology, MIT Japan Program, MITJP 94-01, pp. 7, 21.

peacekeeping operation in Cambodia where it had to be able to locate the border with Vietnam since inadvertently crossing the border could have created an embarrassing political situation. When asked about the possibility of "information warfare" in Japan, he replied that "battlefield feudalism" still prevailed as a hangover from the Imperial Japanese Army in which the breakdown of hierarchy was more feared than any enemy. Information innovations that do not respect proper channels do not have a hope in Japan.

Discussions at MITI's Aviation and Ordnance Division revealed an institutional concentration on traditional platforms, primarily aircraft. The fact that it is the suite of subsystems on the platform and the integration with other, dispersed systems that contribute to the platform's military effectiveness was not in their job description, literally. The staff said that the law establishing their oversight of military industry limited the scope of their interest. These other subsystems and technologies "must be covered somewhere else in MITI." As presently constituted, the Aviation and Ordnance Division is not a likely player in a military-technical revolution.

## V. The Possibility of Military-Technical Revolution in Japan

**The Increasing Importance of Civilian Technology.** We are seeing the end of the mid-20th century experience of high military expenditures, vigorous military competition, the military adoption and extension of civilian technology, and the rapid development of tactical-technical innovations in military operational art and doctrine. Not only was there a motivation in this period to develop, procure, and incorporate new systems and technologies into force structures, but feedback from one's own operations, from allies and other buyers, from war, and from enemy reactions kept the practice of military thought at a high level.

That era is now drawing to a close as we enter a new "normalcy." Civilian technology is moving at its own swift pace. Wholly new technologies, products, and services are emerging based on numerous and unpredictable market experiments. U.S. military electronics R&D is only about three percent of total electronics R&D in this country, and about one percent of the global effort. The military will be able to take advantage of ready-made capabilities, with their methods and uses already worked out. Since these capabilities are available on the world's markets, they will be obtainable by any nation able to afford them.

As the railroad and telegraph helped to transform military operations in the mid-19th century, the emerging technologies will also be adaptable to those with the imagination to see their military applications. Such applications can be made with little delay since their use will already have been demonstrated. These kinds of technologies are different from the application of civilian technology to, say, artillery or tanks where wholly new concepts had to be developed. Of course, the emerging civilian products could also feed into such purely military uses.

Japan has not been at the forefront of many of these emerging systems. Its participation in such areas as computer-driven, multi-media telecommunications has been hobbled by regulation, weak entrepreneurship, and a deficient venture capital market. However, Japanese companies are likely to be the major suppliers of system components. This would be equivalent to producing locomotives even though a nation lacked an integrated rail network.

An undeniable area of Japanese strength has been in production. Over the course of 25 years, Japan's automobile makers, their suppliers, and then a good part of Japan's internationally competitive manufacturers put in place a production system that reduced costs, increased quality and reliability, and shortened reaction times — for both high and low volume production. This economic-technical revolution was one of the most important innovations of the second half of the 20th century. By transforming the way the world made things, this production revolution required many of the same adaptations in companies throughout the world that military-technical revolutions have required among armies.

Several points can be made about the innovative Japanese production system. (1) Intense competition drove the search for efficiency. In 1955, nine Japanese automobile companies fought for an annual market that was equivalent to one day's output of the American auto industry. Efficiency rather than product innovation was the key to profits. (2) This transformation took several decades to reach a state of

comprehensiveness such that it could be identified as a new way of doing things. Its growth was incremental, but driven by a continuous, competitive search for advantage. (3) The abstraction and understanding of this Japanese innovation has allowed it to be transferred globally. It is no longer a solely Japanese product. (4) Efficient, adaptive production could itself be part of a future military-technical revolution. At the mass-production end of the spectrum, low-cost production of rapidly changing products is the key to getting the fruits of new technology into the hands of thousands of combatants; low volume purchases of expensive systems also requires cost minimization to warrant production, especially as procurement budgets decline. For both high and low volume output, fast response to technical opportunities and tactical feedback could play an important role in gaining a time advantage over an enemy. Nevertheless, production is only the means for implementing a military-technical program; it is not the program itself. In order to make a contribution, production innovation has to work hand in hand with military innovation.

A recent survey in Japan on prospects for future technology portrays relative Japanese strengths and weaknesses and confirms the importance of production.<sup>80</sup> Nearly 2,400 experts in industry, universities, and government laboratories were questioned in a Delphi method of repeated surveys on, among other things, the importance and comparative Japanese R&D levels in 1,149 fields. We identified those fields where there was strong consensus among the experts that the fields were both “important” and either Japan or others were “strongly ahead.” Out of the 1,149 fields, 89 were important and Japan was in the lead versus 145 important fields where others led. The differences across fields are striking; Japan was dominant in “Materials and Processing” (8 important fields where Japan was in the lead and 4 where others led), “Information and Electronics” (9 and 1), and “Mineral and Water Resources” (10 and 3). Others (mainly the United States) dominated “Software” (0 and 6), “Life Sciences” (1 and 35), “Outer Space” (0 and 17), and “Health and Medical Care” (4 and 32). This survey indicates significant but not overwhelming Japanese strengths in production and electronics and American dominance in two fields supported by the United States government — health and space. The United States had a dominant lead in software — considered by information warfare experts to be the core technology for future electronic systems. While no more than suggestive, this survey of Japanese experts indicates solid competence in Japan in major areas important to possible military-technical revolutions, but no clear dominance of any field.

**What Could Change?** We stressed above the near absence of tactical-technical savvy in both the Japanese military and industry and related that weakness to pacifist social norms. Major change on the military scene would have to be preceded by very significant social changes. These have occurred before in Japan — the Meiji Restoration and the 1945 defeat mark two such occurrences. Most analysts agree that a withdrawal of American security guarantees would shock Japan into a reconsideration of its military situation. But although this would be a necessary condition for rearmament, it would not be sufficient. A serious threat that was unappeasable by diplomatic or economic means could be the additional factor that would push Japan to a dramatic expansion of military capabilities. “In such an eventuality, given the persistence of Japanese suspicions towards their own military, Japan would then be plunged into the most

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<sup>80</sup> Japan, Science and Technology Agency, *Future Technology in Japan Toward the Year 2020*, Tokyo, 1993.

serious crisis of the postwar era, and the political culture would be likely to change.”<sup>81</sup> Although the political culture could be changed by such a national crisis, rearmament and the creation of organizations and doctrine to implement a new national strategy, possibly including military-technical revolution, would take at least a decade and probably longer.

Short of a cataclysmic shift in national political culture, what else could change in Japan to produce a military-technical revolution? Possibilities are greater in niches that do not challenge social norms. One example is ballistic missile defense. Japan is now witnessing the growth of real threats from its neighbors' possession of medium-range ballistic missiles with the possibility of nuclear warheads. An internal project at one of the Japanese defense companies we visited was directed to ballistic missile defense after the company's review of the threats facing the country revealed this to be the most real and serious challenge on the horizon. The company undertook this work with the belief that eventually the government would come to the same recognition. The government is now financing small efforts in the major defense companies and engaging in discussions with the United States on the subject — at American urging. This area is consistent with Japan's defensive approach to security, it builds on decades of work on missiles, it requires many of the electronics and production skills possessed by industry, and it is unhampered by previous dogma. Japan could also enhance its own competence in this area by working with others, most likely the United States, but also possibly a country like Russia, which has the military expertise but lacks the most advanced technology. Japan already is beginning to build air navigation satellites and is studying intelligence-gathering satellites.<sup>82</sup> If ballistic missile defense were to gain momentum, the lead could be taken by industry rather than by government. However, government would have to give clear indications that such things as the use of space for defensive military purposes were politically acceptable.

The other main possibility is that Japan could work with other countries to supply technology for foreign military-technical revolutions. The most likely candidate for such sharing is the United States, which has long working relationships at both the government and industry levels. The United States and Japan also have in place a military technology transfer agreement. But other countries could be active or passive partners with Japan. For Japan to be an active military technology partner with a country other than the United States, major political and popular changes would have to occur of the type discussed above. However, other countries could also take advantage of Japanese technological capabilities through ordinary commercial means, or through covert activities. Sensitive technology leakage is always a possibility, no less so in Japan than in the United States or elsewhere. If the political foundations of technology control were to collapse, Japan could possibly become a witting or unwitting contributor to military-technical revolution in undesired places. But that scenario would also require a breakdown of international and national norms.

In summary, a deliberate Japanese role in pursuing its own military-technical revolution is unlikely unless there is a historic shift in international relations and domestic Japanese political-social norms. Other necessary conditions would include an immense gain in military-technical capabilities in Japanese industry,

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<sup>81</sup> Berger, "From Sword to Chrysanthemum," p. 148.

<sup>82</sup> Usui, Naoki, "Japan Awaits Launch of 1st Spy Satellite," *Defense News*, January 24-30, 1994; "Hata Supports Acquisition of Spy Satellite in Future," *Japan Times*, June 3, 1994.

including the recruitment of firms and sectors now outside the defense regime. The military also would have to become seriously attentive to the threats facing the country and to its own responses at all levels, from doctrine to organization to training and systems. Such changes could take decades.

In a narrow area, Japan could develop a ballistic missile defense system using new technologies and system concepts if faced with a nation-threatening situation. Such a system would build on industry's technical strengths and would fit the Japanese concept of defensive defense.

Active participation by Japan in the military-technical revolution of another country other than the United States is also unlikely unless similar international and domestic political changes were to occur. Imaginative foreign users could benefit from advanced Japanese products on world markets. Loose export controls could expand the selection, but this too would require major international political shifts. Renegade employees or firms could also deliberately transfer products and technologies.

As a general conclusion, Japan is an improbable source of military-technical revolution in the foreseeable future.

## Epilogue: From Spinoff to Spin-on and Back

In the broad sweep of historic change — as portrayed, for example, by the Tofflers — the notion of the spin-off of military technology to the benefit of the civil sector has little relevance. The military is embedded in the society that gives it form and function. For the past hundred years, it could aptly be said that a country able to make machine tools can make machine guns. Most countries most of the time devote only a small proportion of their resources to military efforts. For example, of the 154 countries listed in the tables of the International Institute of Strategic Studies 1993-94 edition of *The Military Balance*, 48 (just under one-third) had military expenditures below two percent of GNP.<sup>83</sup> Such countries give low priority to advancing military capabilities beyond what the civilian economy can turn out with little extra effort. The United States was in this position from 1870 to the 1930s (except for three years during the First World War) and Japan since 1945. Although spin-off from military to civilian use is possible under such conditions, the small relative size of the military limits the possibilities.

There are other ways, however, to organize societies and their militaries. In the Soviet Union, for example, military power dominated leaders' preferences. They placed top priority on military-industrial development. Some improvements to civilian welfare might flow from these efforts, but that was of secondary consideration. Many of the other Stalinist Communist regimes as well as Hitler's Germany adopted this policy. ("Guns will make us powerful; butter will only make us fat."<sup>84</sup>) Civilian consumption was an undesirable but necessary cost to military supremacy. Japan's post-1868 strategy was a benign version of such a policy until the 1930s. Economic and social development was aimed at the creation of a modern arms industry, but the ultimate goal was to protect the nation from the ravages of the European colonial powers; growth of the civilian sector was allowed to proceed on its own while being enriched by technological and material flows from the military side.

Between the cases of minimal military commitments at one extreme and the values of the military substituted for all other national objectives at the other is the example of the United States and the major European nations in recent decades. This country devoted more than five percent of its total economic output to military efforts for the past half century. It encouraged military industry and technology in areas where civilian capabilities were insufficient for military needs. The military sought advanced technological capabilities from the civilian sector and spent large amounts to improve them and specialize them for military uses. It should not be surprising that these improved technologies often found new homes in the civilian sector from which they had only recently sprung.

Frequently, the U.S. defense establishment was willing to invest in high fixed costs to develop a technology with large military payoffs; such fixed costs could include research and development (either directly or through a stated willingness to pay an average price to civilian producers that included R&D

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<sup>83</sup> International Institute of Strategic Studies, *The Military Balance: 1993-94*, London, Brassey's, pp. 224-228. Another one-third of the listed countries (52) had ratios of military expenditures to GNP in the range of two to four percent; military spending to GNP in the remaining 54 countries (35 percent) was greater than four percent.

<sup>84</sup> From a 1936 speech by Hermann Goering, in John Bartlett, *Familiar Quotations*, 14th Edition, Little, Brown, Boston, 1968, p. 1026.

expenses), infrastructure costs (such as rocket launch complexes), learning curve investments, or the investment in specialized production facilities and equipment. After making such investments, the technologies and products could be available to others at much lower marginal costs. (These are the preconditions for spin-off.) A dual economy emerged from these practices with many parts of military industry and technology gradually diverging from its civilian roots.

Small, big, rich, poor, technologically advanced or backward: these characteristics do not seem to predict the relative size or separateness of military industry. The USSR was large and had a dedicated, technologically competent military industrial sector; however, with the shift in importance to rapidly changing electronics technology, it found itself in the 1980s falling behind the United States with its vibrant civilian electronics industry. North Korea is small, poor, and backward but is dedicated to military priorities. Israel is small, relatively wealthy on a per capita basis, and possesses advanced civilian technological abilities; it places a heavy emphasis on autarky and indigenous, high-technology military industrial competence.

In choosing their policies, many of the advanced countries based their decisions on analyses of the American experience. They saw the impetus that military-technical efforts gave to important civilian sectors: e.g. aviation, computing, nuclear technology, electronics, materials, and certain areas of medicine. What they failed to see was that the United States possessed a highly competent civilian technological establishment that spent enormous amounts on civilian R&D; moreover, military-technical spending during the Second World War and the Cold War was also beyond the scale that could be contemplated by almost any other country. In addition, the technology spinning off from the military was absorbed by a market economy driven by profits and competition. The technology itself had originated for the most part in the very civilian sector that later benefited from spin-off. Countries like France tried to copy the structure rather than the motivating process of American technological leadership. Japan, too, sought, for example, to copy I.B.M. rather than the forces that drove I.B.M.'s success. To Japan's credit, it came to a partial understanding that its meager military spending would not yield the civilian technology benefits enjoyed by the United States. De Gaulle's France, though, wasted billions of francs in efforts that ultimately destroyed many of the industries it was trying to stimulate.

Japan's post-1945 experience was by no means special. Rather, it duplicated what most countries do most of the time. Even the Meiji defense industry buildup was similar to Stalin's policies for the Soviet Union, and for many of the same reasons. In 1931, Stalin provided an evaluation of his country's past failings in a way that would have found an understanding Japanese audience that same year, or indeed 60 years earlier. "Those who fall behind, get beaten. But we do not want to be beaten. No, we refuse to be beaten! One feature of the history of old Russia was the continual beatings she suffered for falling behind, for her backwardness. She was beaten by the Mongol Khans. She was beaten by the Turkish beys. She was beaten by the Polish and Lithuanian gentry. She was beaten by the British and French capitalists. She was beaten by the Japanese barons. All beat her — for her backwardness; for military backwardness, for cultural backwardness, for political backwardness, for industrial backwardness. ... Such is the jungle law of capitalism. You are backward, you are weak: therefore you are wrong; hence you can be beaten and enslaved. You are mighty: therefore you are right; hence, we must be wary of you. That is why we must

no longer lag behind.”<sup>85</sup> The USSR did not scour the world as assiduously as Japan did for technology, but it made use of a great amount of foreign technology, especially in the military industry sector. Russia was importing machine tools from the American builder Brown and Sharpe for the government arsenal in St. Petersburg in the 1880s, for example, decades before Japan. The main Soviet tank factory was built by the Ford Motor Co. in the 1930s as a direct copy of its River Rouge plant. The Soviet armaments ministry then duplicated it several times over. And the T-34 tank, which overpowered German armor for most of the war on the Eastern Front, started life as an American design. It’s evolution bore a certain resemblance to that of the Zero fighter.

Aircraft designers have been frequently heard to remark when they examine the models of other countries, “It seems that the laws of aerodynamics are the same here, too.” Perhaps the forces of politics and economics operate with some similarity from country to country with, of course, a camouflage of local style.

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<sup>85</sup> Quoted in Leites, Nathan, *The Operational Code of the Politburo*, McGraw Hill, New York, 1951, p. 79.

## Bibliography

Alexander, Arthur J., Paul T. Hill, and Susan Bodilly, *The Defense Department's Support of Industry's Independent Research and Development (IR&D)*, R-3649-ACQ, The Rand Corporation, Santa Monica, April 1989.

Alexander, Arthur J., *Of Tanks and Toyotas: An Assessment of Japan's Defense Industry*, N-3542-AF, The Rand Corporation, Santa Monica, 1993.

Bank of Japan, *Hundred-Year Statistics of the Japanese Economy*, Tokyo, July 1966.

Berger, Thomas U., "From Sword to Chrysanthemum," *International Security*, Spring 1993.

Bobrow, Davis B. and Stephen R. Hill, "The Determinants of Military Budgets: The Japanese Case," *Conflict Management and Peace Science*, Fall 1985.

Boyd, Carl, "Japanese Military Effectiveness: The Interwar Period," in Alan R. Millett and Williamson Murray (eds.), *Military Effectiveness: Vol. 2, The Interwar Period*, Unwin Hyman, Boston, 1988.

Chinworth, Michael, *Inside Japan's Defense*, Brassey's (US), Washington, 1992.

Coox, Alvin D., "The Effectiveness of the Japanese Military Establishment in the Second World War," in Alan R. Millett and Williamson Murray (eds.), *Military Effectiveness: Vol. 3, The Second World War*, Unwin Hyman, Boston, 1988.

*Defense News*, "Defense News Top 100," July 18-24, 1994.

Fallows, James, *Looking at the Sun*, Pantheon Books, New York, 1994.

Green, Michael, *Kokusanka: FSX and Japan's Search for Autonomous Defense Production*, Massachusetts Institute of Technology, MIT Japan Program, MITJP 90-09, Cambridge, 1990.

Green, Michael, *Boeizoku: Defense Policy Formation in Japan's Liberal Democratic Part*, Massachusetts Institute of Technology, MIT Japan Program, 92-104, Cambridge, 1992.

Green, Michael, *The Japanese Defense Industry's Views of U.S.-Japan Defense Technology Collaboration: Findings of the MIT Japan Program Survey*, Massachusetts Institute of Technology, MIT Japan Program, MITJP 94-01.

Ienaga, Saburo, "The Glorification of War in Japanese Education," *International Security*, Winter 1993-94.

- International Institute of Strategic Studies, *The Military Balance: 1993-94*, London, Brassey's.
- Japan Defense Agency, *Defense of Japan: 1993*, Japan Times, Tokyo, 1993.
- Japan, Science and Technology Agency, *Future Technology in Japan Toward the Year 2020*, Tokyo, 1993.
- Japan Statistical Agency, *Japan Statistical Yearbook.*, Tokyo, various years.
- Japan Times*, "Hata Supports Acquisition of Spy Satellite in Future," June 3, 1994.
- Katzenstein, Peter, and Nobuo Okawara, "Japan's National Security," *International Security*, Spring 1993.
- Klein, Lawrence and Kaushi Ohkawa (eds.), *Economic Growth: The Japanese Experience since the Meiji Era*, Richard D. Irwin, 1968.
- Krepinevich, Andrew F., "Cavalry to Computers: The Pattern of Military Revolution," *The National Interest*, Fall 1994, p. 35.
- Leites, Nathan, *The Operational Code of the Politburo*, McGraw Hill, New York, 1951.
- Mikesh, Robert C., *Zero*, Motorbooks International, Osceola, 1994.
- Nish, Ian, "Japan, 1914-18," in Alan R. Millett and Williamson Murray (eds.), *Military Effectiveness: Vol. 1, First World War*, Unwin Hyman, Boston, 1988.
- Ono, Naoki, *Learning the Reality of a Sustainable Alliance*, dissertation submitted to the Johns Hopkins University, Baltimore, 1994.
- Opall, Barbara, "Arrow Again Wins U.S. Funds," *Defense News*, November 21-27, 1994.
- Prak, W. "Problems of the Pacific: Causes for War," U.S. Naval Institute, *Proceedings*, July 1935.
- Pyle, Kenneth, "Japan and the Future of Collective Security," in Daniel Unger and Paul Blackburn, eds., *Japan's Emerging Global Role*, Lynne Rienner Publisher, Boulder, 1993.
- Rice, Richard, "Comment," on Yamamura, *Journal of Economic History*, March 1977.
- Rubiner, Matthew, *U.S. Industry and Government Views on Defense Technology Cooperation with Japan: Findings of the MIT Japan Program Survey, March 1994*, Massachusetts Institute of Technology, MIT Japan Program, MITJP 94-03, p. 13.

Samuels, Richard , *“Rich Nation, Strong Army” : National Security and the Technological Transformation of Japan*, Cornell University Press, Ithaca, 1994.

Schodt, Frederik L., *A Report on Military Manga*, 1994.

Shionoya, Yuichi, “Patterns of Industrial Development,” in Klein, Lawrence and Kaushi Ohkawa (eds.), *Economic Growth: The Japanese Experience since the Meiji Era*, Richard D. Irwin, 1968.

Toffler, Alvin and Heidi , “War, Wealth, and a New Era in History,” *World Monitor*, May 1991.

Unger, Daniel and Paul Blackburn, eds., *Japan's Emerging Global Role*, Lynne Rienner Publisher, Boulder, 1993.

United States, Bureau of the Census, *Historical Statistics of the United States* , United States Government Printing Office, Washington, 1976.

United States, *Economic Report of the President.*, United States Government Printing Office, Washington, 1994.

Usui, Naoki, “Japan Awaits Launch of 1st Spy Satellite,” *Defense News*, January 24-30, 1994.

Ward, Michael D., David R. Davis, and Corey L. Lofdahl, *A Century of Tradeoffs between Defense and Growth: the Case of Japan and the United States*, Center for International Relations, University of Colorado, Boulder, February 1994.

Yamamura, Kozo, “Success Illgotten? The Role of Meiji Militarism in Japan’s Technological Progress,” *Journal of Economic History*, March 1977 (Vol. 37, No.1).

Yoshida, Reiji, “New War Novels Reshape History,” *The Japan Times*, January 29, 1994.