Appendix H

Strategic Technology Management in Japan: Commercial-Military Comparisons

SUMMARY

The salient points of Japan's overall research and development (R&D) efforts that have particular importance to the defense sector include:

- *Emphasis on private sector activity. The* private sector seines as the main player in R&D expenditures. Its time horizon is fixed on the long term and management strategies, which emphasize broad analyses of the effects of technological applications on corporate goals.
- *Limited government role. The* government role as an initiator is most prominent when risks are highest and the potential payoffs are not immediately evident. Nevertheless, once a budding technology appears more attractive than present endeavors, R&D is assigned to the private sector. Government strategies assess the role of technology in terms of its impact on the national economy.
- *Strong institutional and informal integration of government and business R&D.* Government and business interact at several formal and informal levels and, in doing so, reach a consensus on R&D directions. While the private and public sectors do not necessarily see eye to eye on all major issues, there is nevertheless a greater degree of cooperation and coordination than is evident in other countries. Moreover, by detailing their own employees to various agencies, government ministries themselves encourage the integration of perspectives and a comprehensive outlook on technology.
- *Emphasis on dual **use** technologies with multiple applications.* Advanced technologies with a single or limited application are not as attractive as those offering multiple applications. The R&D management process tends to weed out technologies with limited applications or defer their development. While spinoffs are desirable, an equally important consideration is "spin-on": applying technology to producing new products or even industries. The close integration of business and government, along with an emphasis on focusing R&D efforts on the 'private sector, help assure the development and utilization of dual-use technologies. It is not a case of developing, say, a process or product in a government military laboratory and then attempting to find applications in commercial fields. To a large extent, military and commercial interests are merged by the institutional structures and management attitudes evident in business and government.
- *An emphasis on research collaboration.* In both military and civilian fields, R&D that is particularly far-reaching tends to organize around private-sector consortia that combine cross-fertilization in the early stages with the benefits of free competition at the point of development. Collaboration is not the sole means of bringing technology into commercial or military marketplaces, but it does play a crucial role.

INTRODUCTION

Although defense R&D expenditures still account for only a small part of Japan's annual budgets, the government is strongly emphasizing the development of indigenous weapons systems and the utilization of domestic technologies for defense applications. The defense policymaking establishment recognizes that Japan's capability to defend itself against potential threats, particularly in the face of a weakening U.S. presence in Asia and a decline of American economic power, rests on its ability to field superior technology in the form of advanced weapons systems. The 1988 issue of "Defense of Japan," the annual statement of defense policies, issued with cabinet approval, declares that:

> It is particularly important to continue efforts to maintain **and** improve the technological standards related to military equipment required for national defense in years to come. Japan is the second largest economic power in the Free World and has a high level of industrial technology capable of independently carrying out research and development projects in the field of high technology. The Defense Agency is conducting research and development by taking advantage of technological expertise accumulated in the private sector. It has been increasingly necessary

for the country to direct more positive efforts to research and development on equipment. [1]

Japanese defense technology strategies are intertwined with a broader process of technology management within government and industry that emphasizes the nurturing of dual-use technologies to assure Japan's security in the broadest sense during the coming century. To understand the thrust of Japanese defense technology management, it is essential to look beyond narrow definitions of defense and security. One must examine the roles and perceptions of a range of business and government interests in formulating and implementing technology management policies as part of a larger economic strategy. The importance given to developing dual-use technologies with multiple applications demonstrates that Japanese technology policies are developed and implemented in a way that merges economic, security, and industrial considerations. As a result, the line between purely defense and civilian technologies is consciously blurred.

This paper examines the mechanisms and policies that result in this policy mix by reviewing: 1) the most important player in Japanese research, the private sector; 2) the nature of industry-government interaction in R&D; 3) the players and processes in defense decisionmaking; and 4) the research patterns evident in commercial research that are manifested in defense-related efforts, as well as the specialized role of defense research offices.

R&D IN THE PRIVATE SECTOR

Japanese management of defense-related technology must be seen in the context of overall R&D in Japan and particularly in terms of the role of industry and government-industry collaboration in achieving targeted goals. In Japan the private sector dominates R&D. Only recently have economic, political and institutional constraints on defense spending moderated sufficiently to identify a more specific defense component in those efforts.

The United States still spends more in the aggregate on R&D than Japan does. Nevertheless, Japan now spends a higher portion of its GNP than the United States does-2.8 percent for Japan, compared to 2.7 percent for the United States in 1985. The Japanese Government estimates that this will increase to 3.4 percent of Japan's GNP by 1990 and 5.3 percent by 2000, compared with 2.9 percent and 3.4 percent for the United States over the same period?

Approximately 50 percent of all U.S. R&D spending is related directly to the military (estimates go as high as 70 percent). The percentage for Japan is far smaller (although increasing) with 80 to 90 percent of all funds-government and private sector combined—directed toward commercial applications. Private sector R&D dominates the Japanese technology process. Whereas half of all U.S. research is funded by the government, approximately 75 to 80 percent of total Japanese R&D allocations reside in the private sector.[3]

These factors have been cited to account for Japan's efficiency in applying new or improved technologies to products. But it is not a matter of funding alone. Business and government give priority to projects that will provide a net technological gain to the domestic economy and/or serve as a source of innovation for other industries and sectors. If the collective evaluation of industry, government, or an individual company is that the potential payoffs are likely to be very significant, investors and researchers will accept an even longer period for the technology to mature. Innovation is viewed not simply as a means of achieving economic breakthroughs, but as a process to be incorporated into every phase of development and production. Japanese firms will invest in a series of incremental improvements in products despite the costs, while U.S. firms often pursue more sweeping—perhaps elusive-breakthroughs.

A basic difference between the United States and Japan is that in Japan engineers, researchers, and other technical specialists are involved both in choosing among potential research projects and in participating in the design and development of new products from the outset. Production and manufacturing considerations are accounted for in the

[1] "Defense of Japan, 1988" (Tokyo: Japan Times, 1988), pp. 135, 136.

[2] Jon K. T. Choy, "Technological Innovation in Japan and the United States," *The World* and/, November 1988, pp. 171-172. The budget for the Technical Research and Development Institute (TRDI), the research and development arm of the Japan Defense Agency, accounts for just 5 percent of total government R&D expenditures. Research in private firms accounts for the remainder of total defense-related R&D.

[3] Ibid., p. 172.

development and design stages virtually from the initial consideration of a promising technology all the way through the production phase. Their incorporation into product design necessitates fewer costly and time-consuming modifications later on. It is still difficult to determine if the same can be said without qualification in defense production, but it would not be surprising if similar attitudes and practices prevailed.

Another fundamental but often overlooked point is that Japanese firms that do not necessarily lead in underlying technologies may still excel in process technology, the mundane but essential capability to produce goods more efficiently than other competitors. Again, this is attributable in part to close cooperation and collaboration among designers and production personnel at the earliest phase of product development.

A final characteristic is top management's commitment to promote technological advances within their companies. While participation of senior managers and corporate officials varies from one firm to another, there is widespread awareness of the need for continuing research. Failing projects can be quickly dropped, and those who first supported them suffer no adverse consequences. Further, research results circulate throughout corporations, extending even to sales and marketing divisions.[4]

R&D IN THE PUBLIC SECTOR

In terms of government funding, the Science and Technology Agency (STA), Ministry of International Trade and Industry (MITI) and Ministry of Education constitute the three largest players in Japan's government-directed research and development. (This paper will focus on the first two. The size of the Education Ministry's budget is partly attributable to its responsibility for managing educational research facilities.) Total government R&D funding will reach 41.71 trillion yen ($8.92 billion) during the current fiscal year, with STA and MITI accounting for 4,431 billion and 4,221 billion yen respectively (see table H-l).

A broad consensus on the value of R&D exists in Japan, one that provides a stable environment for pursuing long-term goals. Bureaucratic organization and more politically oriented activities help assure the preservation and continual assessment of that consensus. STA, for example, is organized under the office of the prime minister, while MITI's research programs report directly to the head of the ministry. At the broadest level, scientific research trends are monitored and influenced by advisory councils associated with the office of the prime minister. These councils fulfill multiple roles, including facilitating cabinet-wide consensus on appropriate government policies and allocation of resources, and legitimizing initiatives developed in the private or public sector by publicly endorsing them. Council reports can often stimulate progress in specific fields. Space exploration, for example, has become a national priority in part because of the role played by these advisory councils in articulating government visions and stirring the national imagination.

Government laboratories and research institutes fulfill a variety of roles in the Japanese R&D process. While government facilities may serve as creators of new technologies or initiators of larger research projects, that is not their main purpose. Rather, such facilities serve to verify, through testing, results achieved in private labs and to carry research to a point where it becomes more economical to turn it over to private-sector facilities. Given these roles, which industry and government clearly understand, it is understandable that considerable business-government interaction takes place at the level of individual researchers, their supervisors, and the directors of respective facilities.

Despite the efficacy of Japanese R&D efforts, the process is not faultless. Inter-ministerial integration and cooperation are not always as thorough as they could be. There have been instances in which ministries have competed against one another for prominent roles in research initiatives, forcing political compromises that wastefully duplicated efforts-competition over budgets for space activities comes to mind. Important initiatives can fail, even when there is a clear consensus of views in government and industry. An aerospace effort in the 1950s, for example, produced the YS-11, a small passenger aircraft intended for commercial use that fell far short of expectations.

[4]Shogo Sakakura of the Japan Society of Science Policy and Research Management details these and other characteristics of Japanese research management in "A Fact Finding Survey of Research Management in Private Research Institutes," MIT- Japan Science and Technology program Paper No. 88-12, Massachusetts Institute of Technology, 1988.

Table H-l–Japanese Government, Science and Technology Budget Allocations Fiscal Year 1988 (mlllions of yen)

Ministry/agency	Total allocations	Percentage change from previous year
Education	812,954	4.2
Science and technology agency	430,955	1.3
International trade and Industry	221226	-0.1
Japan defense agency	82,700	11.6
Agriculture, forestry, fisheries	66,642	-0.2
Health and welfare	44,059	10.8
Posts and telecommunicatlons	30,729	4.3
Transportation	14,627	0.8
Environmental protection agency	7,752	-2.0
Foreign affairs	6,417	1.9
Others	14,894	0.6
Total	1,706,504	3.1

SOURCE: Ministry of International Trade end Industry, Agency of Industrial Science and Technology,

By the same token, a nationwide or govemment-wide consensus on the value of defense production and research for the economy does not necessarily exist While it has been argue-d here that the country has embarked on a policy emphasizing domestic research and development of 'advanced weapons systems, that policy is not accepted. The Ministry of Finance retains as-an article of faith the philosophy that virtually any spending on defense comes at the expense of the economy (thus necessitating active lobbying by industry to convince the ministry of the domestic economic value of, say, an indigenous fighter-support aircraft). A number of major research efforts within the civilian ministries and agencies have clear potential for military applications. Among them 'are artificial intelligence research, high performance plastics, fine ceramics, advanced alloys, jet engine research, and deepsea mining systems, to mention only a few. Although both the public and private sectors are examining possible military applications, the projects nevertheless are justified 'primarily on the 'basis of their expected beneficed- impact 'on the civilian economy.

RESEARCH COLLABORATION

Selective collaborative research, particularly in the precompetitive phase, plays an important role in realizing technological gains 'n the public and private sectors. Although widespread, collaborative research is not necessarily the rule in Japan. The nature, timing and participants of collaborative efforts vary from one field to the next. Nevertheless, collaboration features prominently in Japanese efforts to bring technology to the marketplace. Informal and formal structures and processes tend to identify promising research fields or trends. Once government and industry agree on more specific avenues of research, the establishment of a govern ment-industry venture or a government-sanctioned research consortium often follows. As research proceeds, greater competition is introduced to hasten the introduction of a product to the marketplaces

Interviews with corporate figures suggest that many companies are less committed to the consortium approach than they might have been in earlier decades. Officials argue that important resources are being diverted from corporations to government-sanctioned efforts, with insufficient evidence that programs will produce short- or long-term gains. Some firms suggest that their own resources are sufficient to stimulate technical advances; while not resenting the government's role, they believe it should be reduced or that government should intervene in other ways. But, out of deference to government and a fear that they will miss out on technical developments, these same companies continue to participate in these consortia.

This situation is not likely to change soon. In defense technology, for example, there are a large number of industry consortia including those in composite materials, advanced turboprop research and fighter aircraft. (In some cases, companies will pursue their own R&D projects, with implicit recognition by the Japanese defense bureaucracy that ultimately the project will be funded by the government when it has reached a certain level of maturity or that costs will be recovered by industry through procurement contracts.) Japanese managers feel that the market is too competitive to risk a totally independent course of action. Certain projects, such

[5]For an analysis Of collaborative research in Japan, see Richard J. Samuels, "Research Collaboration in Japan," MlT-Japan Science and Technology Program Paper No. 87-02, Massachusetts Institute of Technology, 1987.

as the FSX,[6] are seen literally as once-in-a-lifetime opportunities that, if neglected, could lead to the complete loss of important capabilities. Cost is another factor favoring cooperation, especially in large-scale projects originating in, but not necessarily limited to, the defense field.

DEFENSE DECISIONMAKING

It is in this environment that Japan establishes its defense policies. As was noted earlier, defense issues have assumed greater prominence in policymaking circles in recent decades. Nevertheless, Japanese defense policymaking remains constrained and is subject to negotiation among competing interests. Historical and institutional factors help explain this situation. For example, broad defense policies-hence, decisions about allocating national resources to major defense R&D programs- are not the sole domain of the Japan Defense Agency (JDA). JDA is not as autonomous or influential within the Japanese government bureaucracy as the Department of Defense is in the United States. Budget constraints have remained severe throughout the postwar era. Until recently, popular and political support within Japan for defense was muted, curtailing the agency's relative influence within government. The agency has been unable until recently to attract Japan's most promising college graduates, most of whom preferred joining more prestigious government ministries, including Ministry of Finance (MoF) and MITT.

Institutional factors also influence JDA's role as one among many in determining defense policies. Multiple players with differing agendas and perspectives interact to generate policies that can be accepted by the government as a whole. While different agencies' interests often compete with one another, this process nevertheless contributes to the formation of policies with widespread government support Interagency negotiation of defense policies tends to integrate economic, security, and industrial policy perspectives.

The most direct form of influence over defense policies is the budgetary power of the Ministry of Finance. On the assumption that the growth of defense budgets represents a drag on the economy, the MoF has used its considerable influence to restrict such growth. In recent years, however, defense proponents have been successful in securing spending increases far higher, on a percentage basis, than those for specific agencies and for the budget as a whole.

Despite this new influence, major defense policy decisions are only recommended by JDA, subject to the approval of the Security Council of Japan, a formal body chaired by the prime minister that includes the ministers of finance, international trade and industry, and foreign affairs, along with such officials as the director general of the Economic Planning Agency (EPA). The Security Council, which replaced the weaker National Defense Council in July 1986, is the final arbiter of such policies as the agency's 5-year procurement plans. The Security Council's influence means that much of Japan's defense policymaking process is intertwined with non-defense interests. Put differently, diverse and wide-ranging interests influence defense policymaking through organs such as the Security Council. These interests include domestic industrial concerns (as represented by MITI), fiscal and monetary interests (represented by MoF), and macroeconomic policy outlooks (in the form of EPA interests). MITT's aircraft and ordnance division is particularly influential in Japanese procurement decisions.

This influence by other ministries and interests in defense policymaking is exhibited within JDA itself. Many key positions there are occupied by officials detailed from other ministries. The director general of the procurement bureau usually is a MITI representative with experience in the ministry's aircraft and ordnance division. The internal finance bureau is staffed by an MoF employee. While this might have drawbacks from JDA's perspective, it also means that by virtue of their service within JDA, a growing cadre of government officials have been integrated into the defense policymaking process.

THE TECHNICAL RESEARCH AND DEVELOPMENT INSTITUTE

It is within this context that the Technical Research and Development Institute (TRDI) operates. Organized as a division within JDA, TRDI is the agency's primary research organization. It is headed by a civilian who oversees three administra-

[6]Fighter Support Experimental.

Table H-2-TRDI Research Facilities

- First Research Center
  - First division: Explosives; ammunition; small arms; artillery
  - Second division: Armor; anti/ballistic structures
  - Third division: Camouflage; parachutes.
  - Fourth division: Hydrodynamics; battleship technology (structures, noise reduction).
- Second Research Center
  - First division: Communications; computer applications; information systems integration
  - Second division: Radar; electronic warfare; microwave antennas/components
  - Third division: Electro-optical systems; infrared systems
- Third Research Center
  - First division: FSX aerodynamics, stability/control, structure and system integration; helicopters; missiles, remotety piloted vehicles.
  - Second division: air breathing/rocket propulsion systems
  - Third division: Missile guidance; fire control systems; sensors; navigation systems
- Fourth Research Center
  - First division: Mine warfare; protective structures
  - Second division: Transmissions, suspension systems, engines, and other vehicle subsystems
  - Test division: Vehicle testing (tanks)
- Fifth Research Center
  - First division: Sonar; underwater acoustics
  - Second division: Torpedoes; mines
  - Field test/evaluation division: Torpedo, mine testing
  - Kawasaki branch: Shipboard degassing; magnetic sensors

SOURCE: SOURCE: "Defense of Japan, 1988."

tive departments, along with four uniformed directors who supervise R&D in ground, naval and air systems, as well as precision guided munitions. Research centers sponsor technological research projects, including survey research and test and evaluation to enable further development on specific systems. Authorized manpower is 1,179, including 256 uniformed personnel rotated from the three branches of the Self-Defense Forces. TRDI maintains five research facilities in Japan to test and evaluate a broad range of weapons systems and technologies (see table H-2 for a complete list of the facilities and their areas of research). The Institute has no prototype manufacturing capabilities, relying instead on private sector capacities.[7]

The R&D component of the Japanese defense budget has grown at over 10 percent annually for the last five fiscal years. TRDI's total budget in fiscal year 1988 (April 1, 1988- March 31, 1989) came to 481.8 billion, ($682 million at current exchange rates), or approximately 2.21 percent of Japan's total defense budget. JDA's fiscal year 1989 preliminary budget request, submitted to the Ministry of Finance in July 1988, included a 12.9 percent increase for TRDI over the previous year's request.[8] Table H-3 shows the growth in TRDI spending, in recent years, as a percent of the total defense budget.

As a matter of policy, JDA seeks to continue its upward R&D spending trend and boost total R&D expenditures to 2.5 percent of the defense budget by the end of fiscal year 1991. Much of this is reflected in decisions to proceed with "big ticket" items for the three services. Major projects include the SSM-1 surface-to-surface missile (from which antiship and other derivatives are anticipated); a new main battle tank to succeed older, domestically developed models; the XSH-60J antisubmarine helicopter, a codevelopment project with the United States designed to replace outdated aircraft; and last, but certainly not least, the FSX next-generation fighter-support aircraft, another codevelopment effort, led by Mitsubishi Heavy Industries from Japan and General Dynamics from the United States. JDA and TRDI also have proposed four specific technology areas for codevelopment projects with the United States. In October 1988, the two countries initialed an agreement to co-develop new missile guidance technology.[9]

Throughout much of its early postwar experience, the bulk of the TRDI research effort was directed toward reinventing the military technology wheel. With limited resources, bureaucratic constraints, a lack of popular support, and other factors hindering R&D efforts, the organization was not capable of launching high-risk projects of its own accord. That situation has begun to change in recent years. With greater public acceptance of defense policies in Japan, TRDI has been able to recruit promising technical graduates from leading educational institutions.

TRDI was established to develop independent weapons development capabilities and enhance the growth of the domestic arms industry. It began with a philosophy of moderating direct participation in

[7] "Defense of Japan 1988," op. cit., footnote 1, p" 137.

[8] Ibid., pp. 137, 312; *Kokubo (National* Defense), vol. 37, No. 10, October 1988, p. 102.

[9] "Defense of Japan 1988," op. Cit., footnote 1, pp. 138-145; Kyodo Economic NewsWire, Oct. 6, 1988. The phrase "codeveloped" often is used in Japan in reference to modification programs involving, for example, changes to a U.S. airframe or other structure to accommodate introduction of Japanese electronics. The missile homing project, however, does appear to involve more fundamental efforts.

Table Technical Research and Development Institute Expenditures as a Percent of Total Defense Spending, Fiscal Years 1968-88

Fiscal Year	Percent
1968	2.01
1976	1.21
1984	1.49
1985	1.84
1986	1.95
1987	2.08
1988	2.21
1991 (goal)	2.50

SOURCE: Boei Kenkyukai, Boeicho, *Jieitai* (Tokyo, 1988), pp. 289-293

defense-related R&D, partly to minimize budget outlays and partly on the assumption that defense spending constituted a burden on the civilian sector and should be limited.[10] For these reasons, TRDI until now has viewed its defense technology spending in light of its impact on the domestic economic and technology base. The Institute does not necessarily target the development of technologies to field specific weapons systems.[11] A consistent criterion for selecting and nurturing technologies has been the impact of any given technology on the commercial sector. The chances that such a technology will be targeted for development are greater if it contributes to the overall industrial base and provides opportunities for other spinoffs. For example, the emphasis placed on radar development reflects industry and government interests as wide-ranging as phased array systems for fighter aircraft, 360° radar for commercial airports, and collision avoidance systems for automobiles. Composite materials is another field offering similarly diverse applications.

Thus, an important element of the Japanese strategy is much like one used in drafting professional football players. Rather than find the best player for a specific position, TRDI often "drafts" the best technology available at the time regardless of the position it plays. What matters is that it is capable of benefiting the "team" over the long run. The U.S. security guarantee, of course, contributes to a situation in which Japan has more flexibility to make such decisions. In assessing this approach for the United States, it is important to keep these comparisons in context. Allowing for contextual differences, however, does not make the underlying principle any less valid for foreign observers.

The combination of a government attitude that defense spending is a drain on the civilian economy and the emphasis on broad technologies has led to government-business cooperation in defense areas. TRDI works with industry formally and informally. In many cases, the organization simply monitors research already under way in private companies. In others, it carries out preliminary research that it ultimately hands over to the private sector, once it has reached a stage where risks have been reduced and the technology has proven itself. The development of the F-1 fighter support aircraft, SSM-1 cruise missile, and T-2 trainer all illustrate that pattern.

These patterns were reinforced by a July 1987 reorganization that totally eliminated minor research programs that could be pursued more effectively by private research facilities. In addition, TRDI's role was defined to include research that lacks an immediately identifiable demand in commercial sectors. This could be an important development for TRDI's institutional role, perhaps representing a judgment by JDA that fielding advanced weapons systems will require selective development of specialized technologies with primarily military applications.

At the same time, a flexible approach was emphasized to incorporate commercial technology in military systems-all with the ultimate aim of making Japan equal or superior to other countries in terms of its defense technology base.[12] This outlook is summarized in the current white paper:

[10] For a discussion of the origins and early projects of TRDI, see Boei Kenkyukai, Boeicho, *Jieitai* (Tokyo: *1988),* pp. 269 ff. (Transli: Defense Research Committee, Japan Defense Agency, *Self-Defense Forces).*

[11] Indeed, JDA has been accused of foregoing the acquisition of systems readily available from foreign suppliers until TRDI could develop the domestic technology necessary to produce a comparable *system, thus* enhancing domestic industry capabilities as well as spinoff/spin-on opportunities. Despite the high priority given by the Ground Self-Defense Forces to fielding advanced tanks, for example, deployment was delayed until a purely domestic *model was developed to* TRDI's satisfaction. Journalistic accounts of the Japanese procurement system also accused the government of delaying consideration of short range surface-to-air missile systems for air base defenses until the Tan- SAM was fully developed. More recently, industry backers of a domestic fighter- support aircraft to replace aging F-is called in 1987 for further feasibility studies and/or the development of a domestic prototype aircraft with the tacit support of the Air Self-Defense Forces, when it appeared that then-JDA director general Kurihara would decide in favor of an codevelopment project with the United States or the acquisition of an American aircraft.

[12] "Defense of Japan, 1987" (Tokyo: Japan Times, 1987), p. 140.

> The Defense Agency will positively utilize the private sector's technology on the basis of its excellent **technology in the field of microelectronics and new materials including ceramics and composite** materials. F reticularly in the area of basic research the Defense Agency will rely heavily on the technology pooled in the private sector. Furthermore, the Defense Agency, carrying out a technological research project to integrate private technology into future high-technology equipment, will build **it up as a system that will meet the unique operational requirements** of this country. Accordingly, the De**fense Agency will achieve effective improvement of** superior equipment capable of competing with **technological standards of** foreign countries.[13]

Institutional and informal mechanisms comparable to those outlined reinforce the use of commercial capabilities for defense in both research and manufacturing. Close links plus the overriding philosophy emphasizing commercial benefits/inputs help assure, first, that military-related research benefits the commercial sector (spinoffs) and, second, that commercial, off-the-shelf technologies are employed as much as possible in military systems (i.e., spin-ens). Even in the case of purely military technologies, TRDI can be expected to continue relying on private-sector development. Business and government will look to these technologies for maximum utilization in defense and commercial applications as well.

PRIVATE SECTOR INTERACTION

The private sector helps to develop a consensus on overall R&D trends, as well as sponsoring specific projects through individual company contacts and various industry associations. The most influential of these groups is probably the Defense Production Committee (DPC) of Keidanren-the Federation of Economic Organizations.[14] The DPC consists of about 10 percent of Keidanren's total membership of 800 industrial companies and over 100 financial institutions.

The DPC's officiate serves functions include:

. compiling basic data on defense production,

- collecting and exchanging information relating to defense production developments and trends among its members,
- promoting cooperation among defense contractors, and
- coordinating defense and non-defense industries and interests.

A fifth, unofficial purpose of DPC is to promote its members' interests among government agencies and policymakers. Given these objectives, it is not surprising that the DPC plays a significant role as a forum for discussion and dissent among contractors on defense issues. The committee will refuse to take stands where industry-wide concurrence is impossible or temporarily beyond reach, but it will promote positions on which there is clearcut consensus. The group issues an annual report on defense-related issues and has consistently favored higher domestic production rates and indigenous weapons development. Most recently, the group called on the government to allocate greater budgetary resources to defense-related R&D, supporting JDA's target level of 2.5 percent of the total defense budget.[15]

Since its establishment in 1952, virtually every DPC chairman has come from Mitsubishi Heavy Industries. While it is beyond the scope of this report to examine the implications of that dominance, it is worth noting that such consistency has given Mitsubishi a means of assuring its preeminent status as Japan's number one defense contractor by projecting its views of defense issues on the domestic industry as a whole.

Other groups playing comparable roles include the Japan Ordnance Association, the Society of Japanese Aerospace Companies (SJAC) and the Japan Shipbuilding Industry Association. In addition, the Japan Technology Association was created in 1980 with the support of commercial firms such as Sony and Honda Motors. These associations, along with other industry interests such as trading companies, can play significant role at the formative stage of major policies, in part because of the lack of

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[13]"Defense of Japan, 1988," op. cit., footnote 1, p. 136.

[14]A dated, but still largely accurate, portrayal of the Defense Production Committee in *action is* David Hopper, "Defense Policy and the Business Community: The Keidanren Defense Production Committee," in James Buck (cd.), *The Modern Japanese* Military *System* (Beverly Hills: 197S), pp. 113–148.

[15]For other Keidanren DPC perspectives, see Editorial Committee, Asagumo Shimbunsha, "Sobi Nenkan,]988," Tokyo, 1988, p. 479. The Japan Ordnance Association expresses its policy positions on pp. 480-482.

outside, independent consultants available to U.S. government agencies to address pending issues.

Senior executives of leading defense contractors who are also officials of these associations routinely serve on key advisory panels for MITI, the defense agency, and other government agencies. These panels, like the Defense Science Board in the United States, are an important conduit of information and influence between business and government. Moreover, it is not uncommon for major companies to provide JDA with technical analyses of competing weapons systems for use in determining a final selection for procurement. Governments in other countries also frequently turn to private interests for such analyses, although Japan lacks the Booz-Allens or RAND Corporations that normally would provide these analyses in the United States. However, since these Japanese firms also act ultimately as the developers, manufacturers, or agents for procuring these systems, their involvement in such fundamental activities gives them significant opportunities to shape the course of future policies in a manner that serves private sector interests. In R&D projects, it also allows them insights into government perspectives that might otherwise be limited or unavailable altogether.

Influence and interaction of industry is further strengthened by the increasingly common practice among major defense contractors, industry associations, and trading companies of hiring retired senior JDA and SDF personnel as advisers in defense matters. This does not differ markedly from practices in the United States, except to the extent that such relationships are usually the result of a 1onger-term interaction than might be evident in the U.S. experience. Furthermore, potential access to higher levels of government is greater if the new adviser retired from a senior position after serving in several ministries throughout his career.

Companies frequently attempt to anticipate major policy developments by forming informal study groups on specific issues. For example, the aerospace department of a major trading company might collect data and examine satellite utilization and technology to identify potential business opportunities. Participants would include representatives from comparable divisions of other companies; by informal agreement, a lower mid-level executive from the organizing company would supervise the group. Government officials might participate informally. If lower-ranking staff identified significant opportunities, the head of the trading company's aerospace department might also become involved. At that point, the focus would shift to one or more of the industry associations, and the participants of the study **group** would disband.

Such early interfirm cooperation can consolidate industry perceptions toward emerging business opportunities, and help identify specific roles for individual companies once projects move into research, development, and production phases. Firms continue to participate in these arrangements because they want to secure some portion of the business resulting from a major procurement decision. The Japanese defense market is an oligopoly, and government procurement decisions reinforce a pattern in which only a few firms can develop specific manufacturing and production capabilities. Given that situation, no one firm will secure the lion's share of a major procurement order. Their participation in the ways outlined above can help them at least a part of the business.

A point to note is that firms at this stage are not necessarily approaching these areas in terms of their potential for military business per se. Instead, they identify and analyze business opportunities in terms of their overall relationship to a company's strategic plans. It has been noted that in the United States the Defense Department fields weapons, not technology. In Japan, on the other hand, where commercial and civil ministry interests are very important, it is safe to say that JDA fields neither technology nor weapons, but products. This is partly because, unlike in the United States, Japan has few out-and-out defense contractors. Mitsubishi Heavy Industries, for example, secures on average about 25 percent of JDA's total annual procurement budgets, which amounts to only 15 percent of its total sales. Distribution of JDA contracts diversifies dramatically once MHI's share is accounted for. Of major contractors, only one, Japan Aviation Company, depends virtually entirely on defense contracts for survival.

Firms are diversifying to emphasize defense-related sales. Thus MHI's 15 percent of sales in the defense field has grown from just over 7 percent a decade ago. Nissan Motors now officially describes itself as a defense contractor in its corporate charter. As was mentioned previously, firms as diverse as Sony and Honda are keenly interested in defense

sales and applications for existing and new technologies. But rather than looking at defense as a new field requiring different marketing strategies, Japanese companies are incorporating their defense strategies as new components of broader commercial plans, emphasizing maximum gains regardless of technology or product.

SELF-IMAGE, EXTERNAL EVALUATIONS AND) IMPLICATIONS

Japanese policymakers and observers alike increasingly view the country's technological capabilities as second only to those of the United States, and even then just barely second in terms of many specific technologies. The 1987 STA white paper concludes that within the past two decades, Japan's inherent technological strength and its potential for future technological development relative to the United States surpassed those of West Germany, France, and the United Kingdom.[16] A recent assessment of Japan's future role in the world, "Nihon no Sentaku" (Japan's Choices), completed by a MITI-sanctioned commission, determined that Japan leads the United States in many critical fields and is closing ground on virtually every other technology that will prove important in the coming century: space communications, launch vehicles, robotics, large-scale integrated circuits, civil aerospace, biotechnology, and artificial intelligence, to name only a few.[17] In its 1984 report on industry-to-industry arms cooperation, the U.S. Defense Science Board concurred that Japanese dual-use technologies offer great potential for advanced U.S. systems. A subsequent DoD task force identified a more specific range of technologies.[18]

These assessments represent an increasing appreciation of Japan's capabilities abroad. They are even more significant in demonstrating Japanese confidence—hitherto restrained-that it has the ability to lead the world in technologies with both commercial and military applications. Of itself, this development should not necessarily cause concern to the United States and other allies of Japan. It could even be viewed as a ringing endorsement of the economic and political systems that assisted such strides through generous technology transfers, a security guarantee that freed resources for commercial gain, and assurances of political stability through a democratic form of government. There have been signs that the effort will have payoffs in the form of U.S.-Japan cooperation. The two countries concluded agreements in November 1983 to allow military technology exchanges, and in 1987 Japan agreed to participate in the Strategic Defense Initiative (SDI). (The first SDI contract involving a Japanese firm was signed recently.) Furthermore, the two countries have embarked on a less heralded project, the development of a new missile homing system, that could be an even more promising augur of things to come.

Nevertheless, it is important to view the Japanese R&D effort in perspective. Japan equates technological advancement with its chances for future survival. The 1987 STA white paper concluded that virtually half of all Japanese economic growth in the 15 years since the oil shocks was attributable to advances in the domestic technological base, compared with 20 percent at most for the United States.[19] (It is safe to say that, in terms of defense outlays, much of the growth on the Japanese side would be attributed to the dual-use, multiple application strategy that has discouraged a focus on strictly military technologies. For the United States, one might conclude excessive attention to strictly military R&D has been a drag on the economy.) These gains have resulted in productivity improvements and the creation of new demand for products that simply did not exist a decade ago. Small wonder the government places a heavy emphasis on maintaining this pace to assure the future vitality of the Japanese economy.

The United States has concluded that its chances for continued global influence rest in large part on the health of its technological base. A critical element in this strategy, however, is the assumption that allied cooperation and technology exchanges

[16] Science and Technology Agency, "Kagaku Gijutsu Hakusho 1987" (Science and Technology White Paper), pp. 40-42.

[17] Ministry of International Trade Industry, "Nihon no Sentaku," Tokyo, 1988, pp. 184-193.

[18] Defense Science Board, "Report of the Defense science Board Task Force on industry-to-Industry Armaments Cooperation, Phase II: Japan," prepared for the Of@ of the Under Secretary for Research and Engineering, 1984, pp. 15-17. U.S. Department of Defense, Office of the Under Secretary of Defense (Acquisition), Research and Advanced Technology, "Electro-Optics and Millimeter- Wave Technology in Japan," 1987, pp. 3-1,4-4.

[19] *Science and Technology in Japan*, vol. 7, No. 26, June 1988.

are essential to assure mutual survival. One must ask if Japan, with its emphasis on retaining technology to assure its own survival, shares that assumption. The answer to that question could have profound implications for this country's relations with Japan in the coming decades.