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U.S. Export Licensing Policy: A Critical Technology Dilemma

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ABSTRACT

U.S. technology transfer through export licensing has been a contentious issue for decades. Initially, national security concerns necessitated some controls over exporting U.S. advanced technology to potential military adversaries. With the emergence of foreign technology competition, now U.S. technology export policies and procedures have been cited as affecting U.S. industry capabilities in the global marketplace. This U.S. national security versus industrial competitiveness issue prompts a debate about whether U.S. technology export policies should be changed and/or whether U.S. government administration of these policies should be streamlined.

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U.S. EXPORT LICENSING POLICY: A CRITICAL TECHNOLOGY DILEMMA

On November 13, 1990 President Bush announced to the nation:

> "If America is to maintain and strengthen our competition position, we must continue not only to create new technologies but to learn to more effectively translate those technologies into commercial products."[1]

The President's statement was reinforced on June 4, 1991 by Malcolm R. Currie, Chairman and CEO of Hughes Aircraft Company who exclaimed:

> "... it is extremely important that a coherent technology strategy and policy be articulated at the highest national level. In my view, the government must play a more active role in promoting and investing in certain advanced technologies and, particularly, in creating enabling processes for their translation into world competitive products and capabilities."[2]

In a sense, technology is the lifeblood of our nation. Its innovation can provide both a formidable national defense against any potential military threat and a competitive economic advantage in the global commercial marketplace. And as President Nixon once said: "... economic power will be the key to other kinds of power, ... ".[3]

Hence, the objective of this paper is to analyze one aspect of a U.S. technology strategy: technology transfer/export license, as it relates to control of the key technologies

considered critical to U.S. economic and military security. This analysis includes a history of U.S. technology transfer/export license policy, a review and assessment of the status of these critical technologies in the U.S. relative to the rest of the world (using airbreathing propulsion as an example), a summary of the problems with the current national technology transfer policies, and finally a recommendation for future U.S. critical technology policy and how such a policy should be implemented.

U.S. EXPORT LICENSE HISTORY

The U.S. first imposed export controls in 1917 by limiting all trade with enemy countries and their nationals. The first U.S. export controls specifically for weapons were imposed by the 1935 Neutrality Act in a feeble attempt to preclude the country from being dragged into another war. The Neutrality Act became the basis for the current export control policies.

Post-WWII friction between the U.S. and Soviet Union led Ambassador George Keenan to urge a policy of containment of Soviet imperialistic tendencies. Hence, in 1949 the U.S. began technology transfer directly to the European allies to help counter the Soviet bloc threat. The Coordinating Committee for Multilateral Export Controls (CoCom) was formed with the NATO countries (minus Iceland plus Japan and Australia) in 1949 to limit communist bloc access to strategic technology. However, on special technology, the U.S. continued unilateral controls more strict than CoCom controls.

By 1969, Congress began to recognize the need to balance

technology control with promoting U.S. trade so it passed the Export Administration Act (EAA) to limit the items under export control. This Act and its subsequent revisions became the basis for the Commerce Department's export license policies. Congress also passed the Arms Export Control Act (AECA) of 1976 to focus on arms export. The AECA became the basis for the State Department's export control policies. But by 1979, evidence showed the Soviet bloc was using western technology they had gained either legally, illegally, and/or leaked by CoCom to modernize its conventional and strategic forces.[4] This prompted President Reagan in 1985 to direct more export license applications to the Defense Department for review. However, also by 1985 evidence showed that U.S. industry was losing some market share (approx. $9.3 billion) to foreign commercial competitors because U.S. export controls on technology were more rigorous than those of CoCom countries.[5]

Which technologies are considered critical to U.S. economic and military strategy and, therefore, prime candidates for export control? How does U.S. development of these critical technologies compare to that of other industrialized nations?

U.S. CRITICAL TECHNOLOGIES

Many studies have been chartered to define technologies critical to the nation's military and economic health. Four examples are the Defense Science Board (DSB)[6], the Defense Department's Critical Technologies Plan (DCTP)[7], the National Center for Advanced Technologies (NCAT)[8], and the National

Critical Technologies Panel (NCTP)[9]. Although DSB and DCTP focus on defense technologies while NCAT and NCTP address both defense and economic needs, the critical technologies listed by all four are quite similar. Hence, the nation's future military and commercial technology programs may become more interdependent. NCAT indicates the U.S. is the world leader in technology invention but is losing in new product development. NCAT also contends the U.S. is capable of beating any competitor if it establishes a cooperative industrial effort.

Appendix A consolidates the DSB, DCTP, NCAT, and NCTP critical technology lists into six broad areas (materials, manufacturing, information and communications, biotechnology and life sciences, aeronautics and surface transportation, energy and environment) to compare such U.S. technology capabilities with those of foreign competitors'. Appendix A clearly shows many of the technologies considered critical to U.S. military and economic strategy are highly competitive among the industrialized nations. Some of these technologies have historically been U.S. strengths but are now further advanced by U.S. competitors.

Why is the U.S. advantage in these technologies declining relative to other industrialized countries? Perhaps the following review of a perennially strong U.S. critical technology, airbreathing propulsion, provides some clues.

AIRBREATHING PROPULSION INDUSTRY[10]

The aircraft turbine engine industry for both military and civilian aircraft applications has long been a U.S. strength in

the world. However, strong competition is now coming from the Europeans and Japanese. How has export of U.S. engine technology helped the Europeans and Japanese?

In the last two decades, the U.S. engine industry has increased in total shipment value (installed engines, spare engines, and parts and subassemblies) from $15 billion to about $22 billion in 1988 dollars. Approximately 36% of these shipments were exports generating a positive trade balance of $4.5 billion. However, U.S. engine imports also increased significantly since 1970 - from 6% to 30% of the U.S. engine trade business. For parts and subassemblies alone, exports and imports increased from 33% to 50% of the total export value and 26% to 50% of the total import value, respectively.

While the U.S. total shipment value has increased, its share of the total world market has declined since 1970 from 83% to about 62%. Conversely, in the last two decades the European Community (E.C.) raised its share of the world market to 30% (doubled its military market and tripled its civil market).

Coproduction is largely responsible for the E.C. gain as competitive engine suppliers in the 1980s. Former autonomous engine producers have yielded to coproducing engines manufactured under national and international cooperative agreements of two or more engine assemblers. The aforementioned increased trade value of parts and subassemblies reflects this growth in U.S./E.C. codevelopment and coproduction arrangements. Such collaborations are expected to increase in the future. In the western world,

the value of coproduced engines rose substantially from 6% in 1981 to 50% in 1988.

Japan, the E.C., and the U.S. are expected to be the prime world engine suppliers in the foreseeable future. Japan formed the Japan Aero Engines (JAE) consortium of three Japanese engine companies to develop engines. The JAE then expanded into the International Aero Engines consortium with Pratt and Whitney Aircraft (PWA), MTU of Germany, and Fiat of Italy. Japanese industry has entered into codevelopment and coproduction agreements with PWA for advanced PWA engines and are either manufacturing or assembling the PWA F100 engine, Allison T56 engines, General Electric engines (J79, T64, T58), and Rolls Royce/Turbomeca "Adour" engine. Japan is now embarking on engine technology innovation after years of foreign technology imitation through coproduction and codevelopment programs. According to major U.S. engine manufacturers, the Japanese are now ahead of the U.S. in some propulsion technology areas.

E.C. defense companies are eager to exchange technology with U.S. firms while the U.S. has tended to transfer more to Europe than it has received.[11] As a result, U.S. and European technology and production are now roughly comparable with transatlantic subcontracting and joint venture arrangements now in effect. More E.C. and U.S. interdependency has occurred both in terms of shared technology and production capabilities. The E.C. and some of its 17 engine companies expanded their engine technology capabilities by working with U.S. industry through

codevelopment and coproduction programs. Their governments provided low cost loans, tax incentives, and grants for the working capital needed to collaborate with U.S. firms. Rolls Royce and SNECMA have now agreed to cooperate on engines for the next generation aircraft; to share production facilities for advanced alloys; and, along with other E.C. industry, to produce powder metallurgy for high temperature applications.

The U.S. engine industry consists of nine primary companies. Unlike Japan and the E.C. which encourage huge consortia and collaborations for research, development, and production; U.S. engine companies are allowed to collaborate only for research. To foster competition, U.S. antitrust law prevents domestic collaborations for production. Hence, many U.S. companies have been pursuing foreign coproduction/joint ventures to help with funding and market access. The primary U.S. investment mechanism is the government/industry Independent Research and Development (IR&D) program. Companies are allowed an overhead charge on government contracts to supplement investment funds from commercial profits for application to IR&D.

Currently, an ongoing joint U.S. government/engine industry $7 billion Integrated High Performance Turbine Engine Technology (IHPTET) research project is an example of an IR&D funded program to develop leading edge technologies for both military and commercial application.[12] In the next decade, IHPTET is expected to demonstrate technology improving engine thrust to weight by 100% and fuel consumption by 40%. The reduced fuel consumption

alone could save over $12 billion annually. (Foreign industry have been attempting to join IHPTET to benefit from its advanced technology developments but so far the U.S. government has denied their requests.) Despite government encouragement and antitrust allowance, the seven U.S. companies involved in IHPTET are not collaborating - presumably because they do not want to share their expertise with a potential national competitor. This is consistent with the perception, "U.S. firms must also develop cooperative relationships with their domestic competitors ... . Despite the many positive examples of partnerships ... Americans continue to regard cooperation among firms and other private and public agencies with suspicion. The nation is paying heavily for this unwillingness to recognize the potential importance of collaboration ... ".[13]

In summary, both Japan and the E.C. countries have benefitted substantially by using U.S. airbreathing propulsion technology to gain expertise in the propulsion industry; and they are continuing to press for more such U.S. advanced technology. U.S. technology transfer through codevelopment, coproduction, and other joint ventures have clearly promoted this foreign competitiveness. How indicative is the airbreathing engine industry outlined above to U.S. industry in general?

CONSENSUS OF U.S. TECHNOLOGY EXPORT EFFECTIVENESS

The future health of U.S. industry, including the turbine engine industry outlined above, hinges on its success in world markets. Published literature and results from interviews

conducted using Appendix B questions indicate U.S. industry is competing in the world markets somewhat at a disadvantage. The following is a summary of findings based on this literature and the interviews.

Industry representatives interviewed believe industry cannot stay strong by giving up leads in technology. But they admit to holding very little back from foreign companies in order to gain foreign market share. As in the airbreathing propulsion industry outlined above, U.S. industry in general is more likely to collaborate with foreign companies than with their fellow U.S. industry. Their "know how" - usually the last thing companies give up - can easily be transferred through offsets and joint venture programs. The Japanese in particular and the E.C. to a lesser extent are noted for pressuring U.S. industry into sharing its best technology as a condition for allowing sales in their countries. (Perhaps the recent Boeing 777 sale to Japan is such an example where the Japanese government received offsets from Boeing and is heavily subsidizing three manufacturing firms - Mitsubishi, Kawasaki, and Fuji Heavy Industries Ltd. to produce much of the aircraft.)[14] One U.S. industry representative stated that U.S. industries are "peddlers" and they'll give away anything which is good for the company in both the short and long term. This was corroborated by a knowledgeable government representative who indicated that U.S. companies tend to give away more than the U.S. government would allow and sometimes, industry likes the government to appear as the "bad guy" in their

technology transfer/export negotiations with foreign companies.

Both government and industry representatives interviewed agreed that U.S. companies' technology transfer to foreign companies through offsets and joint research and development programs can jeopardize their U.S. supplier base and ultimately, reduce U.S. technology advantage and employment opportunities. For years the concern has been that the U.S. is "selling its comparative advantage by making its technology so readily available to other countries".[15] In the late 1970s an academic observer noted in Foreign Policy that "U.S. firms may contribute to both the deterioration of the U.S. trade balance and to the loss of the U.S. technical leadership by establishing foreign manufacturing affiliates and by licensing their technology to foreign manufacturers.[16] Also, Fortune magazine reported that "quite a few U.S. businessmen are beginning to worry that the U.S. is exporting too much technology for its own good ... [and] that a lot of foreign products incorporating acquired technology from the U.S. are beating out American products in markets around the world - including the U.S. itself.[17] One highly regarded technology expert reports, "there are no indications that joint ventures have a beneficial effect, either on market competition or on the competitiveness of the participating firms".[18]

Loopholes in the U.S. government's export licensing systems are also cited in the interviews. Industry representatives confirmed that confusion exists in knowing which government agency has jurisdiction over particular export licenses and which

of the conflicting export criteria are applicable. For example, the same turbine engine industry technology can be denied export when submitted through the State Department but approved for export if certified by the Federal Aviation Administration and submitted for export license through Commerce Department. There is at least one example of such a technology transfer. Also, CoCom countries tend to export more advanced technology than the U.S. by virtue of its less restrictive policies relative to the U.S. policies. In particular, Japan and West Germany are noted for their lenient interpretations, if not violations, of CoCom technology transfer controls in order to improve their markets in the former U.S.S.R. and, in the case of West Germeny, to further salvage East Germany. CoCom does not have an adequate enforcement mechanism.

There are probably several options for improving U.S. competitive and technological advantage in the world market. Perhaps some of these are revised anti-trust laws, better tax incentives for advanced technology research investment, better education programs, or a focus on long term strategy versus short term profit.[19] But one such area clearly needing improvement is U.S. technology transfer/export licensing administration.

U.S. TECHNOLOGY TRANSFER/EXPORT LICENSE PROBLEMS

National export license policies are being blamed for the entire spectrum of being too lax to being too strict. In the former case, U.S. technology transfer to Iran and Iraq is cited as detrimental to our national security interests. In the latter

case, U.S. companies report numerous examples where foreign governments' more lenient technology transfer/export license policies give their companies advantages against U.S. companies in global market competition.

Since 1987, the President's Export Council has been recommending an overhaul of the export control process to improve both the level of U.S. competitiveness and the level of U.S. security.[20] In 1988 this export council followed up by recommending more effective control of military critical items and cited inconsistent enforcement of controls by CoCom members. Also, the U.S. unilaterally controls some items which are readily available in other western countries and exported by those countries. This puts U.S. firms with similar, controlled technology at a disadvantage in competitive markets.[21] Further, the export council's subcommittee on export administration has been expressing concern over the tendency of the State Department involving itself in determining export disposition on products and technologies primarily civilian in application. The subcommittee believes this involvement invariably causes a competitive disadvantage for U.S. industry.[22]

Consequently, the Omnibus Trade and Competitiveness Act of 1988 chartered the National Academy of Sciences and the National Academy of Engineering to examine national security export control policies and recommend corrective actions. Results of the National Academies' efforts were published in 1991.[23] Some of the U.S. export control problems cited by the Academies were

multiplicity of statutes, agencies, and regimes; jurisdictional disputes and overlapping enforcement; outdated and confusing U.S. control lists; and U.S. unilateral controls.

Multiplicity of statutes, agencies, and regimes severely encumbers the export control process because of the varied objectives and criteria involved. Over 12 U.S. government departments and agencies (not including a number of internal divisions within departments implementing conflicting technology transfer actions) are involved in export control and at least five control lists (excluding nuclear) are used by the agencies.[24] Considerable confusion results in government and industry over which agency has jurisdiction; especially when items have both military and commercial applications. State Department (in coordination with Defense) has cognizance over the U.S. Munitions List (USML). The Commerce Department uses the Commodies Control List (CCL), a dual use list embodied in the CCL, and has cognizance over the International Industrial List (IIL) and International Munitions List (IML) - subsets of the CCL and USML respectively. Treasury, Agriculture, Justice, Energy, and Arms Control and Disarmament agencies along with all the intelligence agencies also get consulted. Despite recent efforts to reduce these lists, they still overlap.

Overlapping enforcement and jurisdictional disputes arise because no clear standards exist to establish the responsible agency. Because of their separate interests, agencies are often unable to integrate various national interests (security,

economic, foreign policy) to agree on control policy of disputed items. Resolution is often time consuming and frequently involves industry in helping reconcile interagency squabbles. Resulting delays jeopardize export potential as well as risking technology transfer that should be protected.[25]

Outdated and confusing U.S. control lists exist due to no clear definition and criteria for control and decontrol and varying/inconsistent lists for both domestic and international items. Foreign availability assessments to determine control requirements are ineffective and their development costly and contentious. Moreover, lack of communication between agencies sometimes results in multiple agencies working the same case without the other's knowledge.

The National Academies consider widespread unilateral export controls by the U.S. as counterproductive. U.S. reexport controls (a country in receipt of U.S. goods or technology is required to gain U.S. permission before reexporting it to a third country)[26] encourages foreign manufacturers to avoid U.S. sources if possible. To correct these problems, the National Academies recommend a National Security Directive that would define/clarify the policies and procedures for streamlining the multiple statutes, updating and maintaining the export control lists, and addressing any other incongruities that currently exist.

What are the options for addressing these technology transfer problems?

U.S. TECHNOLOGY TRANSFER/EXPORT POLICY OPTIONS

Alternatives to deal with the above mentioned technology transfer problems can be condensed into basically four options.

Option #1: More restrictive technology export policy;

Option #2: Unchanged technology export policy;

Option #3: Less restrictive technology export policy;

Option #4: Streamline technology transfer process.

Advantages and disadvantages of these options are summarized below.

Option #1

The advantage to making technology transfer more restrictive is that more U.S. advanced technology could be protected - reducing its proliferation to foreign countries that would use it to compete with the U.S. either militarily or economically. In a recent speech to business and political leaders in Copenhagen, Denmark, General Schwarzkopf commented that the West needs better control over companies exporting advanced technology to ensure it doesn't fall into the hands of leaders like Saddam Hussein.[27] But to select this option, the U.S. must have confidence that it can maintain a technological advantage in its products sufficient to maintain and expand its competitiveness in global markets. This competitiveness must be sufficiently strong to enable U.S. companies to reject those potential markets which insist on technology transfer as a condition for the U.S. sale.

The disadvantage to more restrictive technology export policies is that they inhibit the U.S. from using its more powerful tools in gaining global market share. Problems with the

U.S. defense industrial base, the expected shift from defense to commercially driven innovation, and the importance of exports to the U.S. economy have all led to a growing realization that economic factors must be given increased weight in the formulation of U.S. national security policy.[28] For a given industry, know-how diffuses quickly via product sales, patents, licensing, publications, etc.. Hence, the potential is remote that one firm or one country can hold the lead in a particular technology for very long without investing to advance this technology.[29] Therefore a more restrictive technology export policy could reduce U.S. sales, reduce resulting revenues which contribute to further technology research investment, and encourage the competitive countries to further develop their technological capabilities to "fill the gap". Denying transfer of technology that already exists or can be easily developed elsewhere does not preserve U.S. military security but could damage U.S. trade competitiveness. In effect, the U.S. would begin conceding some world markets to other competitors. Also, further technology restrictions could provoke suspicion among U.S. trading partners at a time when the U.S. is trying to encourage more open market cooperation worldwide.

Option #2

Some would contend that the advantage to not changing our current technology export policies is that the current U.S. system has gained it the leadership in many world markets and the country is not that bad off. It has a system of checks-and-

balances between the various government agencies whose objectives generally range from encouraging export of technology for improved trade balance (primarily Commerce Department), to using technology for foreign policy purposes (State Department), to imposing strict technology transfer controls on military products for national security reasons (Defense Department).

A disadvantage to not changing our technology export policies is that our dependence on world markets has been increasing in order to keep our industries healthy. Projected military budget cuts may necessitate an even stronger U.S. reliance on world markets than before. With foreign competition in technology increasing - especially from the E.C. and Japan, U.S. accustomed success in the world markets is being challenged. Tailoring our technology export controls to be responsive to new world market opportunities such as Eastern Europe, Latin America, and Asia could prove critical to continued U.S. industrial growth.

Option #3

The advantage to relaxing U.S. technology transfer controls is that near term gains in global markets should be realized as U.S. industry markets more of its strength - high technology. With declining budgets, U.S. domestic sales may not be adequate to keep unit costs tolerably low. By making U.S. technology more accessible to foreign customers, U.S. industry can negotiate for reciprocal access to foreign technology - something from which the U.S. can benefit but has no current policy.[30] As outlined in

the airbreathing propulsion section of this report, the Europeans and Japanese demonstrated how international partnerships with the U.S. gained them access to critical technology. This can work both ways. (An example is the recent French selection of IBM to enter into a partnership with the French company, Groupe Bull, to manufacture computers and computer parts. IBM will supply important microchip technology and Groupe Bull will share its expertise in multiple microchip "brain" technology. Each company stands to gain "hundreds of millions of dollars per year".)[31] By receiving foreign technology, the U.S. then could apply more of its research investment to areas where the potential payoff to U.S. industry is greater.

The disadvantage to relaxing U.S. technology export controls is the higher risk that critical technology will be exported that results in serious detrimental effects on U.S. economic and defense security. Thus, relaxation of such export controls can only be accompanied by improvements/corrections to the aforementioned technology transfer/export license problems. The potential consequences of relaxing any particular export control must be fully assessed by technical experts who understand the significance of the key technologies outlined above and in Appendix A. No such relaxation should occur until this assessment is completed for both U.S. military and commercial impact (i.e. advantages/disadvantages of U.S. weapon system effectiveness to counter threats employing this advanced technology, advantages/disadvantages to U.S. industry in

marketing this technology versus competing against a foreign company applying this technology, etc.).

Option #4

The advantage of streamlining technology export licensing procedures is that a more efficient system becomes also more effective for industry in gaining in the competitive markets. Depending on how U.S. government agencies' responsibilities are streamlined/modified, it should also reduce the potential for inadvertent technology export by a U.S. agency unfamiliar with the critical nature of the technology. For example, the expected decline in the Defense Department budget and resultant decreasing defense procurements force industry to consider more foreign sales (either commercial and weapons related) to help compensate for reduced U.S. market potential.[32] Licensing approval of a foreign sale could be processed by any of several government agencies which have their own unique (dis)incentives for the sale. A properly streamlined U.S. export licensing system could better provide constancy of purpose in addressing corresponding technology transfer/export licensing issues.

The disadvantage of streamlining technology export licensing procedures is that such an initiative could affect "rice bowls" in many government agencies and, hence, may be difficult to achieve without Presidential direction. Also, some of the current system's checks-and-balances between agencies may be forfeited to the detriment of U.S. interests if streamlining is not accomplished properly.

RECOMMENDATION AND SUPPORTING RATIONALE

Recommend Option #4 be implemented as first priority by establishing a single government agency responsible for overall technology transfer/export licensing.

Why is a separate agency needed? "Decisions to cooperate internationally entail careful assessments about what technology must be held back for competitive advantage and national security - and what can be shared for today's sales, market access, and the benefit of commercial and defense alliances."[33] Only a separate agency can perform this function properly.

As previously described, the current export licensing system is both inefficient and ineffective in controlling critical technology transfer and yet maintaining U.S. global market competitiveness. Too many government agencies and export lists get involved in the licensing process leading to fragmented licensing authority, interagency disputes and potentially illadvised technology transfer licensing mistakes. Our current export licensing system endangers U.S. economic vitality, military supremacy, and overall national security and will continue to do so unless a major change is made.

Assigning the overall export licensing responsibility to any of the government agencies as currently structured is not recommended. Department of Commerce generally promotes export and has a history of approving/issuing export licenses unilaterally over the strong objections from other agencies. This has resulted in some military equipment being exported to

questionable destinations (e.g. Iran and Iraq) which probably would have been denied had other agencies reviewed the license requests. The Commerce and State Departments have trouble sharing information on export violators. Evidence shows the State Department approved numerous export licenses for a company while unaware the Commerce Department denied export license requests from the same company because of its previous license violations.[34]

The State Department's mission to cultivate foreign relations has also resulted in questionable exports believed to have contributed to Iraq's weapon programs. Evidence shows that the State Department has exported military equipment and technology transfer over Defense Department objections which also found its way to Iraq through Brazil. In fact, several examples exist where regulations would suggest rejection of proposed export licenses to Brazil but were ultimately approved for diplomatic reasons.[35]

The Defense Department certainly has a vested interest in the health of U.S. industry since industry provides many of the defense systems. This translates to a strong Defense Department interest in U.S. industry competitiveness. (Ironically, some evidence shows the Defense Department is very concerned about the loss of critical technology through commercial channels but less concerned of potential adverse commercial implications of military agreements for coproduction.)[36] Defense Department's Defense Technology Security Administration (DTSA) relations with

counterparts in State Department's Bureau of Politico-Military (P/M) Affairs and Commerce Department's National Security Prepardness Division's Bureau of Export Administration (BXA) are very cooperative. The communication and dispute problems seem to be among the many other offices in the State and Commerce Departments which have their own priorities with technology transfer/export license issues. However because of its focus on military versus economic security, the question still remains as to whether designating Defense the overall authority for export license approval is the best option.

Therefore a separate technology agency is needed - let's name it the U.S. Advanced Technology Agency (USATA) - with overall technology transfer/export licensing responsibilities. DTSA, P/M, and BXA should be consolidated into the USATA and constitute the core of USATA which would then draw employees from other U.S. agencies where they are experienced in working advanced technology issues including technology transfer.

Although outside the scope of this research, consideration should also be given for additional research into the feasibility of making USATA a cabinet level position and assigning it overall responsibility for the nation's advanced technology strategy. To a degree, Defense Advanced Research Projects Agency (DARPA) serves that function for defense related technology issues. The USATA could consolidate DARPA requirements into a broader national strategy by objectively weighing the national security interests of trade balance, foreign relations, and military

threats versus U.S. military strength. USATA could make unilateral decisions on what technologies should be developed and how they should be protected for the U.S. grand strategy. USATA could assess the educational requirements for technology, coordinate the government - industry - academia technology research efforts to focus in the important areas, and provide the appropriate protection and/or sharing criteria. USATA would establish the methodology for advanced technology exploitation into commercial and military products. In essence, USATA's national technology vision would dictate the country's advanced technology national strategy from basic research to export policy.

Appendix A
CRITICAL TECHNOLOGIES COMPARISON; U.S. VERSUS FOREIGN

Materials[37]

The U.S. focus is on studying properties of novel materials and leads in high performance/aerospace material applications. High performance ceramic composite research and development is a U.S. strength. Also the U.S. is the largest producer and consumer of advanced composites - mostly in the high performance space and military aviation.

The Europeans and Japanese are gaining advantage in the microelectronics industry. The Europeans are strongly committed to ceramic research and, along with Japan, supply the U.S. its high grade ceramic powders and fiber reinforcements. Europe is competing well with the U.S. now in high performance metals and alloys - expecially in commercial applications when U.S. industry is oriented more toward military and aerospace markets. France, Germany, and the U.K. focus on separate segments of advanced metals and then share between them where the U.S. tries to cover the entire spectrum.

Japan is formidable in material processing technologies and is the world leader in low cost laser production for compact disc players and long distance fiber optic communication systems. Japan is a major developer of intermetallics and pioneered the use of aluminum automobile engine components.

Manufacturing[38]

Manufacturing trends are toward rapid product introduction, short life cycles, and integrated quality control. U.S. computer

integrated manufacturing is double that of Japan. But Japan has the world's largest automated machine tool industry and dominates the world in development of next generation products. U.S. nanotechnology (atomic scale) is strong but the Japanese capabilities provide them the lead in advanced memory chips and other microelectronic devices and the majority of the world's semiconductor market. Intelligent processing equipment (robotics, sensors, controls) was once controlled by the U.S. but now, since the mid-1980's, much of the market share has been lost to the Europeans and Japanese.

Information and Communications[39]

These technologies include software, high performance computing, imaging and displays, sensors, data storage, and computer simulation. The U.S. leads in the high performance computer market, in software development, and also in optical fibers. Sensor and signal processing is a U.S. strength primarily because of military and aerospace programs but translating it into the commercial market has been a problem. Simulation and modeling techniques are also strong in the U.S. but the Europeans and Japanese are gaining rapidly.

However, European software capabilities are sure to strengthen as a result of the EC '92 initiative. Likewise, public and private European initiatives are underway to compete in the high performance computer market.

Japan is the world leader in photonics related technologies and semiconductor based optoelectronic devices. Japan dominates

in memory devices which is the largest of the integrated circuit market and is becoming more competitive in high performance computing. In high definition imaging and display technology, the Japanese are ahead and the Europeans a close second with the U.S. far behind.

Biotechnology and Life Sciences[40]

This includes molecular biology and medical technology. U.S. still maintains a good overall lead in the medical biological field but is trailing Europe in medical technology. Many European countries have become strong competitors with the U.S. in diagnostic, preventive, and curative products for human health. Germany has strong pharmaceutical companies and has a positive trade balance with the U.S. in medical technology. Japan has developed nonmedical applications for food products, waste management technology, and biochemicals and has 85% of the world market in such related miniaturized electrode technology.

Aeronautics and Surface Transportation[41]

Aeronautics leadership applies to both the commercial aviation market place and military air superiority. As a result of direct government support, Europe is now on par with the U.S. in aerodynamics and structures and ahead in some advanced materials for new aircraft designs. The U.S. still leads in airbreathing propulsion although France is now the international leader in missile ramjet propulsion. Also Japan's research in ultra heat resistant materials could give it major advances in hypersonic airbreathing propulsion.[42] In the commercial

transport aircraft area, the U.S. must rely on advanced aeronautical technology to be competitive with foreign companies heavily subsidized by their governments. Diffusion of U.S. technology through international joint ventures has given the U.S. access to foreign aerospace markets but has also stimulated a rise in imports.

Surface transportation technologies have been advanced in Europe and Japan where magnetic levitation systems have been demonstrated by both Germany and Japan.

Energy and Environment[43]

Energy and environmental technology has commercial potential and worldwide research momentum. The U.S. has achieved significant gains in solar energy markets and Germany and Japan lead research in photovoltaics (converting solar energy into electric current). The U.S. market in photovoltaics has decreased by 34% in eight years. Pollution control has been an international leader for U.S. industry but substantial international research efforts are now underway in advanced pollution controls.

APPENDIX B

INTERVIEW QUESTIONS

1. What technologies are held back from other countries?

2. What technologies should be held back?

3. What are the mechanisms for controlling our technology transfer (civil and military) and do these mechanisms overlap needlessly? How?

4. Who is responsible for technology control/transfer?

5. Who should be responsible for technology control/transfer?

6. How is technology development funded?

7. To what extent do offsets factor in financing technology advancements?

8. What % of U.S. industry R&D is accomplished in U.S./foreign?

9. How does this compare with past/future expectations?

10. How much is industry restricting use of technology in systems to make their products marketable overseas?

11. What are the impediments to developing technology quicker?

12. Do Europeans share their technology with U.S. with equal reciprocity?

13. What changes are needed to improve U.S. investment in technology advancement?

14. What changes are needed to improve U.S. product marketability in the world?

15. What changes are needed to improve U.S. strategic advantage over rivals (both economic and military) in the world?

NOTES

1. National Center For Advanced Technologies, The NCAT Strategy, Key Technologies for the Year 2000, pg. 2.

2. Ibid, pg. 32.

3. Paul Kennedy, THE RISE AND FALL OF THE GREAT POWERS, January 1989, pg. 413.

In July 1971, President Nixon told a group of news media executives that five clusters of world economic power existed. These were western Europe, Japan, China, Soviet Union, and the U.S.. President Nixon went on to say: "These are the five that will determine the economic future and, because economic power will be the key to other kinds of power, the future of the world in other ways in the last third of this century".

4. National Academy Press, FINDING COMMON GROUND, "U.S. Export Controls in a Changed Global Environment", Appendix G, pgs. 314-315.

President Carter restricted sale of U.S. grain and denied any technology export licenses to the U.S.S.R. as a result.

Sen. Henry Jackson acknowledged this problem on May 4, 1982 before the Senate's Permanent Subcommittee on Investigations of the Committee on Governmental Affairs.

Richard Perle stated on June 9, 1983 that most every new Soviet weapon was being produced in part using modern technology and know-how acquired in the West.

5. Ibid, pg. 318.

6. Defense Science Board, "RESEARCH & DEVELOPMENT STRATEGY FOR THE 1990s", Vol. V, Technology & Technology Transfer Task Force, pg. 3-10.

The Defense Science Board classifies U.S. critical technologies in two categories. One category is technology which both sustains technological competency, makes evolutionary improvements in warfighting capabilities, and supports revolutionary innovations. Examples are airbreathing and chemical rocket propulsion, aerodynamics, fluid dynamics, munitions, nuclear technology, software engineering, control systems, and acoustic detection. The second category is technology which provides significant warfighting advantage, has no reasonable substitutes, and has at least three years time constraint for migrating the technology to controlled countries. Examples of these technologies are integrated circuits, advanced software, infrared focal planes for space surveillance and tactical targeting, flexible manufacturing, auto target recognition, counter stealth, stealth technology, simulation/modeling/training, simultaneous engineering, brilliant systems, hypermedia information management, and satellite survivability.

7. The Department of Defense, "CRITICAL TECHNOLOGIES PLAN", for the Committees on Armed Services United States Congress, of 1 May 1991.

The DCTP describes 21 technologies considered essential for maintaining the qualitative superiority of U.S. weapon systems and outlines investment strategies to manage and promote the development of these technologies.

8. National Center For Advanced Technologies, The NCAT Strategy, "Key Technologies for the Year 2000", pg. 32.

NCAT identifies a similar list of critical technologies and indicates U.S. industry leads the world in technology development but is losing in new product development and resulting world market share. NCAT contends that once a cooperative industrial effort is established in our free enterprise system, the U.S. is likely to produce a technical momentum greater than that of the Japanese and European efforts.

9. Report of the National Critical Technologies Panel, of March 1991.

This report consolidates into six broad areas those critical technologies identified by others considered essential to national defense and economic prosperity.

10. WL-TR-91-2066, Draft report "DOMESTIC AND FOREIGN TRADE POSITION OF THE UNITED STATES AIRCRAFT TURBINE ENGINE INDUSTRY", of June 1991; pgs. 5-16, 23-25, 30-34, 60-62, 76-80.

11. Congress of the United States Office of Technology Assessment, "GLOBAL ARMS TRADE", OTA-ISC-460 of June 1991, pg. 23.

12. Aerospace Industries Association Newsletter, Vol. 4, Number 1 of June 1991.

13. Michael L. Dertouzos, Richard K. Lester, Robert M. Solow, MADE IN AMERICA, the MIT Press of 1989, pg. 140.

Better cooperative relationships (such as partnerships, business ventures, research consortia) between government, business, labor, universities, etc. are promoted here. Because the nation is failing to capitalize on this very important opportunity which can advance national economic growth.

14. David Field, THE WASHINGTON TIMES, October 29, 1991.

Japan Airlines plans to buy $2 billion worth of the Boeing 777 - a $100 million per copy airplane with a capacity for 340 people. Japan Airlines also has ordered 20 McDonnell Douglas' MD11

15. David H. Blake, from THE POLITICS OF GLOBAL ECONOMIC RELATIONS, 3rd edition, of 1987, "Technology Transfers and International Relations", pg. 166.

One post-WWII Japanese strategy was to keep out imports so that their firms could become competitive under the protection of their government. In the same article, Robert Gilpin was cited as arguing that U.S. multinationals investing overseas has seriously damaged the competitive position of the U.S.. The technology advantage once enjoyed by U.S. companies has been reduced sharply through transfer of technology.

16. Jack Baranson, FOREIGN POLICY, "Technology Exports Can Hurt Us", No. 25 (Winter 1976-77), pg. 180.

17. Herbert E. Meyer, FORTUNE, "Those Worrisome Technology Exports", May 22, 1978, pg. 106.

18. Jacques S. Gansler, AFFORDING DEFENSE, The MIT Press, 1991, pg. 256.

Gansler discusses the dissipating technological capability of U.S. industry due to teaming because industry is being frozen into one technology approach. He asks the question: "Are we doing anybody a favor by trying to keep everybody alive with a teaming arrangement"?

19. AVIATION WEEK & SPACE TECHNOLOGY, September 16, 1991, pg. 23.

According to Thomas J. Murrin, Dean of the Duquesne University School of Business, our biggest problem with maintaining industrial leadership is national will. U.S. citizens have not decided that global industrial competitiveness is extremely important. He cites the American CEO as evaluated on his quarterly performance whereby a Japanese CEO is evaluated no more frequently than every few years.

20. Colby H. Chandler, Chairman of the President's Export Council, ltr to Honorable Frank C. Carlucci of March 17, 1987.

The council believed there was significant room for reform in the export control process and urged efforts for accountability and consistency to the interagency review process for export licenses. The council cited the changing dynamics of world markets and U.S. competitiveness as dictating a better government policy toward trade.

21. Colby H. Chandler, Chairman of the President's Export Council, ltr to President Reagan of March 29, 1988.

The council urged strengthening the CoCom system of multilateral export controls for military critical items. This letter indicated nearly half of U.S. products marketed outside the U.S. were controlled even though many other countries outside CoCom have industrial and technological capabilities to provide these products. Hence, potential customers seek non-U.S. sources which adversely impact U.S. competitiveness.

22. Arthur H. Hausman, Chairman Subcommittee on Export Administration, President's Export Council ltr to Honorable

Richard G. Darman of April 5, 1989.
This subcommittee wrote that a competitive disadvantage is placed on civilian commercial business transactions because of the overreach of the Munitions List which is not responsive to commercial requirements.

23. National Academy Press, FINDING COMMON GROUND, U.S. Export Controls in a Changed Global Environment, pgs. 171-175.

24. House of Representatives Report 102-137, UNION CALENDAR No.93., First Report by the COMMITTEE OF GOVERNMENT OPERATIONS.
The report cites the existing export licensing system as inherently inefficient and cannot do much better because of the many agencies involved. Commerce and Defense use different criteria and have different standards for judging and approving certain types of licenses. In the absence of any decisive information on an export transaction, Commerce officials favor licensing the product even if the product is too much for the customer's needs. Defense favors persuading the exporter to substitute a less capable product.

25. Ibid., Additional views of Hon. Jon L. Kyl.
The Congressman believes more is needed to ensure national security is adequately addressed in the review of export licenses. He states the Defense and State Departments are not adequately consulted in the export licensing process and that national security should be the primary consideration in determining final approval or disapproval of an export license.

26. Bill Gertz and Rowan Scarborough, The Washington Times, March 18, 1992, pg. A7.
The current dispute between U.S. and Israel over Israeli technology transfer of U.S. weapons to Third World countries is one such issue. Possible Israeli transfer of Patriot missile technology to China without U.S. concurrence is supposedly confirmed by U.S. intelligence but denied by Israel.

27. The Washington Times, January 30, 1992, pg. A2.
General Schwarzkopf said a lot of the Iraqi President Saddam Hussein's technology came from the West because of greed. It's up to the West to ensure more advanced technology does not fall into the hands of leaders like Saddam Hussein.

28. National Academy Press, FINDING COMMON GROUND, U.S. Export Controls in a Changed Global Environment, pgs. 42 and 43.
The U.S. is the world's largest international trader and is becoming nearly as dependent on exports as its major competitors. Therefore, its economy is more vulnerable to the negative effects from export controls.

29. Ibid., Appendix B. pg. 225.

30. Defense Science Board, "RESEARCH & DEVELOPMENT STRATEGY FOR THE 1990s", Vol. V, Technology and Technology Transfer Task Force, pg. 3-10.

Defense Department's assured access to defense critical technologies has been threatened by foreign investment in certain U.S. high technology companies and their subsequent movement overseas. With foreign companies leading in some technologies, no effort exists for the U.S. to gain access to those technologies. No systematic effort exists to make assured access a fundamental consideration in foreign investments or technology transfer.

31. Laurence Hooper, The Wall Street Journal, "France Chooses IBM to Bolster Groupe Bull", of January 29, 1992, pg. A3 and A6.

This agreement makes Bull competitive with IBM in the emerging market for important microchip technology. Bull will sell IBM some portable computers which will "fill a hole" in IBM's market.

32. Charles Wolf Jr., The Wall Street Journal, "Arms Transfer: A Trade That Needs Policing", of March 16, 1992, pg. A14.

In October the five principal/first tier arms suppliers - France, China, Britain, U.S., and Russia - agreed on a nonbinding arms trade pact. They will make a serious attempt at restraint of arms exports to the third world that could aggravate existing armed conflict or introduce destabilizing military capabilities. However, restraint by these first tier suppliers may actually encourage the second tier suppliers to fill the void.

An option is for the U.S. to try to endorse and enforce binding limitations on global arms trade. But this would be opposed by U.S. industry and would incur probable breaches by firms and governments of other supplier countries. Nevertheless, potential U.S. adversaries depend almost entirely on international weapons market to meet their needs. Hence, control of the arms market can significantly limit the extent to which nations would be capable of posing threats to vital U.S. interests. An essential part of U.S. strategy for the new world order should be to develop mechanisms for controlling and regulating the arms market.

33. Virginia C. Lopez, David H. Vadas, A Global Perspective, The U.S. Aerospace Industry in the 1990s, Published by The Aerospace Research Center, AIA, September 1991, pg. 92.

Countries that are concentrated on entering the aerospace market-or developing a stronger market position- have less to fear from possible export of technological capability than the U.S.. There are sound national security reasons and cost savings associated with technology cooperation between the U.S. and other countries as well as strategic business reasons to cooperate.

34. House of Representatives Report 102-137, UNION CALENDAR No. 93., First Report by the COMMITTEE OF GOVERNMENT OPERATIONS pgs.

11-18.

35. Ibid.

36. National Academy Press, The Competitive Status of the U.S. Civil Aviation Manufacturing Industry, Washington, D.C., pub. 1985, pg. 96.

Defense Department negotiation of bilateral Memoranda of Understanding (MOU) with other NATO countries is a concern. Defense generally seeks quid pro quo in negotiating an MOU but it does not necessarily involve technology or commerce. Thus allies' cooperation may have high potential for adversely affecting the U.S. competitive status.

37. Ibid, pgs. 7-27.

38. Ibid, pgs. 31-47.

39. Ibid, pgs. 51-77.

40. Ibid, pgs. 81-89.

41. Ibid, pgs. 91-99.

42. The Department of Defense, "CRITICAL TECHNOLOGIES PLAN", for the Committees on Armed Services United States Congress, of 1 May 1991. pg 14-22.

France also has a program on hydrogen-fueled, high-speed, air-launched weapon technology. These capabilities are a result of a joint venture between SNECMA and SEP (called HYPERSPACE).

Japan has a strong interest in scramjet and combined-cycle engines. They are accelerating efforts to develop methane-fueled ramjet engines capable of stable flight to Mach 5.0 and of combined cycle ramjet-turbojet engines. With their research initiative in ultra heat resistant materials for application up to 2000 degrees Centigrade, major Japanese advances are possible in hypersonic airbreathing propulsion.

43. Report of the National Critical Technologies Panel, of March 1991., pgs. 103-113.