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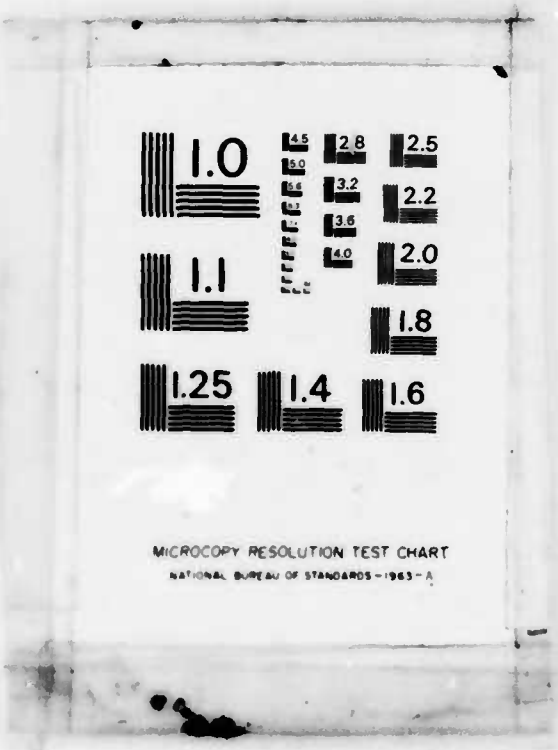
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STUDENT ESSAY

THE CONTROL OF MILITARY ELECTRONICS MANUFACTURING TECHNOLOGY

BY

COLONEL JACQUES C. NAVIAUX

20 DECEMBER 1983

CORRESPONDING COURSE

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PENNSYLVANIA

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USAWC ESSAY

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by

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20 December 1983

ABSTRACT

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THE CONTROL OF MILITARY ELECTRONICS MANUFACTURING TECHNOLOGY

> The military power yielded by states today, and particularly tomorrow, will be determined by the level of scientific development and the extent to which it penetrates the field of military affairs. ....In the age of missiles and the atom, to lag behind in the utilization of scientific and technical achievements in the interests of military science could lead to irretrievable consequences.

This quote, taken from The Officers Handbook - A Soviet View[1] very clearly expresses the Soviet perspective, a perspective that is manifested in their drive to achieve world superiority in technology. In striving to reach this goal, the Soviets have taken two approaches. Internally, they have established the world's largest technical manpower base of some 900,000 scientists and engineers as opposed to 700,000 in the United States, coupling this manpower with the world's largest military industrial base.[2]

At the same time, Soviet leadership is cognizant of the inadequacies of their political and economic system which tend to stifle rather than encourage innovation. As a means of compensating for this handicap, the Soviet Union has turned to the Western World, allocating vast resources to the legal and illegal acquisition and assimilation of technology. Furthermore, we can expect to see a sizeable increase in this effort in the future according to Admiral Bobby R. Inman, the former Deputy Director of the Central Intelligence Agency.[3]

The Soviets have been successful in achieving new levels of military capabilities through their utilization of western technology and production methods in electronics, thus narrowing the technology gap between the Soviet Union and the United States. Although the actual extent to which the Soviets have been able to absorb technology obtained from the United States and the long-term impact of such acquisitions was questioned by Thane Gustafson in a 1981 Rand Corporation study,[4] no one really questions the need to protect direct military technology, particularly in the area of strategic weapons.

We have a growing concern over technology. Where we once had a clear lead over the rest of the world, we now lag in some areas while in others, our lead is eroding at an accelerating rate. The growing

awareness of our dependence on technology for national survival was summarized in the 1984 United States Military Posture Statement prepared by the organization of the Joint Chiefs of Staff (JCS). According to the JCS, "The importance of technology in the world's balance of power has never been as obvious as it is today. The realization that Soviet military capabilities are in part a result of technology gained from the West has been a catalyst to the awareness."[5]

At a national level, we are focusing on the erosion of our technology. Our concern over the bleeding or possibly hemorrhaging of our technology is exceeded only by our frustration at our seeming inability to develop and implement an adequate protective control system. This frustration will undoubtedly result in a long and bitter debate over the renewal of the 1979 Import Export Act, which expired on 30 September 1983.[6]

Technology has many aspects, but unquestionably, the most dramatic and significant technological advances in the past quarter century have been in the field of micro-electronics. The most critical aspects of this technology are the know-how and the equipment used to manufacture the devices for the transfer of manufacturing technology is an irreversible process. Once it has been exported, our ability to exercise any control over the technology is very limited. The gaining country can transfer the technology to a third country, use it to make devices that are sold to third countries, or use the technology to compete with the United States. While our greatest concern is that such technology could be transferred to the Soviet Union where it would be used to improve their military capability, we can no longer ignore the potential long term economic impact associated with the creation of industrial competitors. In either situation, the transfer of manufacturing technology represents a worst case risk.

The purpose of this essay is to examine the policies and practices associated with the control over the transfer of military electronics manufacturing technology for adequacy and consistency with national objectives. The basic research methodology employed was to conduct a series of structured interviews with personnel involved in the decision

process in industry and government. The interviews were structured in the sense that a standard questionnaire was utilized as a point of departure and as a means of seeking consensus. The conclusions and recommendations are based on this research coupled with publicly available documentation and five years of personal experience in technology transfer decisions.

The growing interest and concern over technology transfer has resulted in the rapid and continuing proliferation of organizations involved with various aspects of the process. In addition to government and military organizations, industrial associations such as the Aerospace Industries Association and professional societies such as the American Institute of Aeronautics and Astronautics have working committees, as do various academic groups. Washington abounds in consultants and specialists as well, and most embassy staffs have at least one member who is primarily concerned with technology transfer. During the interview process, virtually every encounter uncovered another group or organization concerned with some particular aspect of the problem. Covering all of these organizations was well beyond the scope of this research task; therefore, a concerted effort was made to cover a reasonable cross section. A sizeable amount of very significant material derived from these interviews had to be excluded due to its classified or sensitive nature.

Approximately one third of the people contacted in key U.S. government positions were absolutely unwilling to grant an interview or to discuss the issues. Others were willing to discuss the issues only on a non-attribution basis; hence, the bibliography does not represent the full extent of the interviews. In the cases of those individuals who were unwilling to discuss the issues, their refusals were all based on one of two grounds. The first was that they had not been in their position long enough to have developed any expertise, although presumably, this did not relieve them of their decision making responsibility. The second reason given was that the individuals really were not involved in the decision process, they were merely administrators. The former is a problem since the issues are complex and

the guidance confusing. Some of our difficulty may well be attributable to high turnover rates in both government and military personnel involved in the decision process. In the case of those who claimed to be mere administrators, one can only conclude after looking at individual titles, grades, and positions on organizational charts that we have experienced excessive grade creep in certain areas if these individuals were indeed mere administrators.

We have maintained a policy of selling weapons to our allies since WWII. Beginning with the sale of the F-16 to the NATO consortium, purchasers of the equipment have become more and more insistent upon technology transfer as a condition of the sale. For the country involved, coproduction is usually not based on a desire to reduce costs, although it may be based on a desire to reduce balance of payment deficits. Countries are willing to pay a substantial premium in order to increase the technology level of their industrial base and as a means of gaining an increased measure of independence in the support area. The Japanese have often elected to pay two to three times the purchase cost of the system in order to gain manufacturing technology through licensed coproduction.[7]

The manufacturing of electronic devices is particularly appealing. It has all of the advantages - it's clean, capable of providing large numbers of jobs for well educated people, and it has the public impact of introducing 21st century technology into local industries. All of these attributes are greatly appreciated by political leaders who have to justify the taxation burden. The requirement to furnish employment of this nature through the purchase of technology is particularly acute in countries that have extensive social legislation.

While our original policy was to limit the transfer of manufacturing technology to NATO countries, Japan, Australia, and New Zealand, other countries are now demanding coproduction and technology transfer as a condition of sale. Egypt, for example, has some very clearly annunciated policies regarding technology transfer.[8] Much to our frustration, many countries have very poor security controls. In addition to the risk of having the technology passed on to the Soviets, many countries have very

few laws that provide for the protection of proprietary data on an industrial basis. In at least one NATO country, we are conducting government-to-government negotiations in an attempt to induce them to adopt more stringent laws. All this leads to a general feeling that is particularly prevalent among members of the armed forces that anything transferred overseas will be compromised. Unlike civilian members of the government, members of the armed forces face the possibility of having compromised technology used against them in combat, and hence, they tend to take a very conservative view in matters of technology transfer.

For U.S. firms engaged in highly competitive procurements such as the F-16 versus the F/A-18 sales to Canada, Australia, Spain, and Turkey, industrial offset has been one of the key items in the competition. Major offset proposals inevitably involve the transfer of manufacturing technology. Local industries view the programs as vehicles for obtaining both capital equipment and know-how, and the competitive nature of the procurement places the purchasing government in a strong negotiating position. U.S. firms involved in the transfer usually receive substantial revenues or offset credits in the form of licensing fees, technology transfer fees, and royalties. Profit margins are higher, and funding profiles are very attractive, providing for substantial or even total advance funding.[9] The potential rewards are so sizeable that companies are often willing to accept the risk of creating an overseas competitor in order to reap short term gains.

The transfer of manufacturing technology requires industrial cooperation of the closest degree, cooperation that goes well beyond the process of transferring data. It involves a long term close relationship between employees at various levels in the engineering and manufacturing disciplines. As a corollary, industrial cooperation equates directly to technology transfer. This corollary was highlighted by a recent Defense Science Board study concerned with cooperation among our NATO allies.[10] Stated in another way, without technology transfer, there can be no real industrial cooperation.

The export of technology is controlled by two laws. The export of commercial and dual use technology, which has both commercial and military applications, has been regulated by the Import Export Act of 1979 which expired on 30 September 1983.[11] Military equipment exports are controlled by International Traffic in Arms Regulations (ITAR).[12] Although the export of military hardware and technology is not legally affected by the Import Export Act of 1983, it is affected by the perceptions and documentation associated with that act; therefore, the salient features of the Import Export Act are summarized in this essay.

The act is an outgrowth of the 1949 Export Control Act in which Congress implemented controls over exports in the name of national security for the first time in a peace time environment. These export controls have remained in effect in various degrees since then, for the export of merchandise is a privilege and not a right. The Export Act of 1979 left the Department of Commerce as the responsible agency for the approval of export licenses, but made the Department of Defense (DoD) responsible for evaluating proposed exports for their potential military value. This act further directed the Department of Defense to develop a list of critical technologies as a means of providing a policy basis for licensing decisions. This list, called the Military Critical Technology List (MCTL),[13] emphasizes the arrays of knowledge and equipment that could, if exported, provide a significant increase in military capability to the importing country. The MCTL is to be used as a guideline for those individuals involved in the licensing process for dual use technology to aid in their recommendation as to whether or not the export license should be granted.

The Commodity Control List is a list, generated by the Secretary of Commerce, of those technologies that require a validated license. Most commercial export transactions are conducted under a general license which permits the exporter to ship commodities without having to apply for a license document for each transaction. A validated license is subject to case-by-case scrutiny, and must be obtained for each transaction of an item on the Commodity Control List. The Military Critical Technologies List is used for guidance in the process of

validating the license. The Commodities Control List is also used as a basis for the COCOM list of controlled items.

COCOM, the Coordinating Committee for Multilateral Export Controls, is an informal organization that had its genesis in 1948 when the U.S. sought to implement a coordinated embargo against the Communist bloc. COCOM operates as a multilateral organization meeting weekly in Paris to attempt to restrict the export of critical technology to the Communist bloc. It is not an official organization, for its decisions are not binding. COCOM membership consists of the NATO countries, less Iceland and Spain[14], plus Japan.

ITAR, or the International Traffic in Arms Regulations, contains a list of controlled military items which cannot be exported without a license from the Munitions Control Agency of the Department of State. ITAR covers the export of technical data as well as hardware. Technical data is defined by ITAR as being any data which is used to operate, maintain, or manufacture the item.[15]

DoD Directive 2040.XX[16] provides the methodology for staffing license applications that are submitted in accordance with ITAR. The license request is submitted to the Department of State, Board of Munitions Control. The Department of State in turn refers the case to DoD. The key DoD function is the Office of the Under Secretary of Defense for Policy, who is charged with formulating DoD policy and coordinating the staffing of all munitions cases. The Under Secretary of Defense for Research and Engineering is responsible for technical matters. The Assistant Secretary of Defense for International Security Policy is responsible for monitoring compliance with the directive. The Chairman of the Joint Chiefs of Staff provides operational and military impact assessments, while the Director, Defense Intelligence Agency is designated to serve as a focal point for all intelligence related activities.

The directive also establishes a panel that is charged with identifying differences within DoD on technology transfer issues. This panel is chaired by the Assistant Secretary of Defense for International Security Policy with the Principal Deputy Under Secretary of Defense

Research and Engineering serving as Vice-chairman. In addition to the chairman and the Vice-chairman, the panel members consist of representatives from the Office of the Deputy Under Secretary of Defense for Policy, Defense Security Assistance Agency, the Office of the Joint Chiefs of Staff, the Defense Intelligence Agency, the Military Services, and the National Security Agency. The panel is called the DoD International Technology Transfer (IT2) panel. A subpanel is tasked with resolving differences within the DoD. This subpanel, chaired by the Deputy Assistant Secretary (International Economic Trade and Security Policy), Office of International Programs and Technology, consists of representatives from the Office of the Joint Chiefs of Staff, the Defense Security Assistance Agency, the Military Services, and the National Security Agency.

Munitions cases are referred to the DoD, and in theory staffed through the most cognizant offices. Contentious cases are referred to the IT2 subpanel and then the IT2 panel. Of the cases handled by the Department of State, very few ever reach the IT2 panel; the vast majority are resolved at a much lower level.

The staffing procedure is simple and direct in theory, but complicated in practice by the size and complexity of the Department of Defense. Staffing requests, which should always go to the organization most concerned with a particular technology, occasionally go astray. In one recent case, a manufacturing technology transfer license which would probably have been denied by one branch of the service was staffed through another branch and approved. Seasoned bureaucrats have learned to protect their flanks by establishing their own monitoring systems, systems which may no longer be required with the completion of the FORTIS system. This system, an on-line interactive computer system, will provide the Department of State and the Department of Defense with a common data base and tracking system.

The difficulty comes in making the determination. As one executive from the Navy said, "All I have to do is make a judgment as an omnipotent expert with a fathomless technical depth and an intimate knowledge of worldwide availability of this particular technology, as to whether or

not the Soviets have it or can get it from other sources, and as to the potential economic impact of the decision."[17] He might have also added as to whether or not the country and particular company involved have the capability, motivation, and legal system to provide national and industrial security. Furthermore, since technology transfer equates to industrial cooperation, then the determination must be made as to whether or not such cooperation is consistent with our national interests.

Obviously, the decision is fraught with ambiguity and uncertainty. On one hand, we have NATO cooperation memorandums which involve industrial cooperation. We have long standing efforts such as the Technical Cooperative Programs which were formed to prevent the needless duplication of effort among our allies.[18] On the other hand, we have an increasing tendency towards isolationism. Our attitudes toward the transfer of technology have been heavily influenced by the attention directed towards the illegal export of dual use technology and the recession. These attitudes have a major impact on the release of manufacturing technology under ITAR even though there is little evidence available in the public domain to support the contention that past releases of military manufacturing technology have been passed to the Soviets.

Our allies are angered at what they see as wild swings in our policy. The two-way street concept of NATO arms industrial cooperation has not materialized in the eyes of the Europeans. The very predictable result is that the Europeans are tending to develop and produce their own systems, specifically excluding U.S. participation. In the long run, this will have a very serious impact on our NATO ties. Furthermore, it will mean that the limited defense budgets of the Western world will be used in the inefficient duplication of development and production. One very senior Royal Air Force officer remarked that although he recognized that the cost and risk associated with a particular development program would be greatly reduced by collaboration with a U.S. company, the fickleness of U.S. policy on technology transfer made such a collaborative arrangement unacceptable.

At least the individual decision maker in Washington has a sizable amount of technical expertise available. The services in general, and the Navy in particular, make use of the technical expertise available in their laboratories. For example, NOSC San Diego has developed and maintains a very extensive data base on microcircuits. The U.S. Army is in the process of preparing a desk top manual on technology transfer that is geared to the working engineer, and the U.S. Air Force Systems Command is preparing a manufacturing technology release standard.

The Military Critical Technologies List is also utilized as a guide in licensing decisions. The list does not address end items of intrinsic military utility; however, it does list critical technologies in the form of arrays of know-how, keystone equipment, materials, and goods accompanied by sophisticated know-how.[19] The list, which is classified, has been criticized by both government and industry as being too broad and all encompassing. The general opinion seems to be that the list could be used to ban anything. Both government and industry feel that the list should be shortened and at least partially declassified.

There is a general acceptance of the fact that we cannot build a wall around the United States, nor can we exist in isolation. We will continue to sell arms as a matter of national policy. These sales will be accompanied by offset requirements, offsets that will involve the transfer of manufacturing technology. The technology must be controlled, but the application of controls in our society is a difficult task at best. When the controls have to be applied to technology, the task is almost overwhelming as evidenced by the number of people and organizations grappling with the problem. Despite the complexity and difficulty of the task, we have made some progress. In 1974, when technology transfer was included in the competition for would-be F-16 suppliers, one senior executive failed to find anyone in Washington who would or could define the boundaries of the technology that could be transferred.[20] While the policy issues will always be convoluted, at least the decision maker now has technical support.

No one interviewed felt that our current practice of case-by-case consideration of each transfer application should be altered; however, no one interviewed felt that we had a consistent and understandable policy that could be implemented, agreeing with the position taken by the Joint Chiefs of Staff who pointed out our lack of a "comprehensive and effective technology transfer control policy."[21] The issue is certainly not being ignored. The Secretary of Defense has established an OSD Steering Committee on National Security and Technology Transfer tasked with defining both technologies and controls[22] in addition to all of the other organizations involved in the attempt to develop policies and procedures.

The most significant shortcoming in our existing approval system is that it fails to consider the long range economic impact. Furthermore, under the case-by-case methodology, each case is treated in near isolation, ignoring aggregate effects. Although the transfer of technology to the Soviet Union is a major concern, the long range economic impact will have the most profound impact on our national security. The failure of the existing system to properly consider this impact was highlighted by Dr. Lomacky[23] and has also been noted by the Government Accounting Office (GAO). The GAO concluded that the economic assessment currently performed by the Department of Defense is too narrowly focused. They recommended that the Secretary of State, in conjunction with the Secretaries of Commerce, Treasury, Labor, and other relevant agencies, develop a policy that would fully recognize the implications of coproduction programs.[24] While this is certainly an admirable goal, the probability of all of these organizations banding together to produce such an all inclusive policy in a reasonable time frame is low indeed. The technical and procedural aspects of the problem appear to be fairly well in hand. We need to focus on economic and policy issues.

If we truly believe that our national security is dependent on our technology, then we should act accordingly, developing and implementing a national policy. Such a policy must address two aspects of the problem. One aspect is, of course, the control or protection of our technology,

while the other and probably most import aspect is the generation of new technology. Our ability to control technology will always be limited in a free society; therefore, while we do need controls, we must recognize their limitations and take steps to enable our industrial and scientific base to regain and strengthen our technological leadership.

Under our economic system, we believe that economic incentives provide the most suitable motivations. Industry should be provided with economic incentives to increase research and development expenditures. Increased research and development tax incentives, increased coverage for Independent Research and Development (IR&D), and relaxation of the antitrust laws to permit more collaboration between companies on high risk developments would all serve to increase the quantity and effectiveness of our research and development expenditures.

We also need to provide controls over military technology. Our greatest concern is in the strategic area. We always face the very low probability but not impossibility of a technological breakthrough that could drastically alter the balance of power, hence the technologies associated with strategic weaponry require very stringent security controls.

In the tactical weapons area, the degree of protection or control should be determined by national policy objectives coupled with long term economic impact analysis. Technology transfer which equates to industrial cooperation can be the key to strengthening Western forces as well as our political ties. The Western World can ill afford to spend its limited defense budget on duplicative efforts, which it will unless we implement a consistent policy that permits industrial collaboration. Furthermore, our own technology could be strengthened in certain areas by the infusion of offshore technology.

We need to define the requisite degree of protection required through long range and continuous economic impact analysis in technology transfer decisions. While including the Departments of Commerce, Labor, and other relevant agencies might be appropriate for deliberations involving dual use technology, the economic impact analysis of military items should be conducted under the auspices of the Department of Defense, but with

industry participation. We need to insure the continued existence of an industrial base that is capable of meeting our requirements. This can best be accomplished by establishing an Industrial Participation Group. This group, which could be structured around the IT2 panel augmented by industrial members, would serve as a long range economic planning group for the defense industry, acting as a focal point for impact analysis in technology transfer cases.

Technology transfer can have both favorable and unfavorable effects. On the favorable side, it can produce the funds required to finance the next generation or lead to the acquisition of offshore technology. On the negative side, it can result in the total demise of a critical defense industrial capability should that industry prove to be incapable of meeting offshore competition. In the case of the latter, we would have to make a decision as to whether or not to subsidize a particular industry in order to maintain a special capability, or whether we should attempt to develop or obtain new technology to either replace that capability or make the industry competitive.

We should take the following steps with regard to our policy and procedures on the transfer of electronics manufacturing technology:

1. Continue the existing procedure of case-by-case approval.

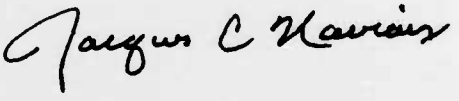
2. Augment the IT2 Panel with industry participants forming a Defense Industrial Production Group. This group, operating under the auspices of the IT2, would have the responsibility for long range economic impact assessment in technology transfer cases. It would be further concerned with the survival of our defense industrial base by formulating policies to protect critical U.S. technology, and to obtain offshore technology where applicable.

3. In recognition of differing trade practices and laws, the transfer of sensitive technology should be done on a government-to-government basis, particularly in those countries that have weak or non-existent proprietary protection laws.

4. In recognition of the fact that technology is a highly perishable commodity, and our ability to protect it by any control mechanism will always be limited in a free society, formulate long range policies to stimulate research and development.

5. Work with our allies towards providing a greater amount of multi-lateral protection through the expansion of COCOM.

If we believe our own estimates of the criticality of technology, we should act accordingly. Even if we don't believe our own estimates, we should certainly take those of the Soviet Union seriously enough to react. This essay has only addressed one part of the problem, i.e., the legal transfer of military electronics manufacturing technology. It is certainly recognized that the overall problem is much larger. In fact, the totality of the technology transfer problem is so complex that in a dynamic world, we can never hope to achieve a total solution. We need to focus on the critical elements, i.e., those technologies which most effect our national security in order to take action before in the words of the Soviets, we are faced with "irretrievable consequences."



FOOTNOTES

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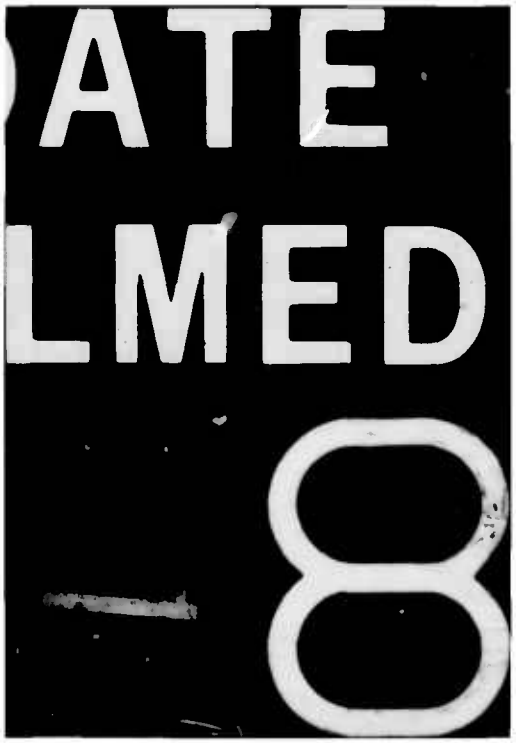
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The directive also establishes a panel that is charged with identifying differences within DoD on technology transfer issues. This panel is chaired by the Assistant Secretary of Defense for International Security Policy with the Principal Deputy Under Secretary of Defense

The difficulty comes in making the determination. As one executive from the Navy said, "All I have to do is make a judgment as an omnipotent expert with a fathomless technical depth and an intimate knowledge of worldwide availability of this particular technology, as to whether or

fickleness of U.S. policy on technology transfer made such a collaborative arrangement unacceptable.

least the decision maker now has technical support.

national policy. Such a policy must address two aspects of the problem. One aspect is, of course, the control or protection of our technology,

relevant agencies might be appropriate for deliberations [illegible]
use technology, the economic impact analysis of military items should be
conducted under the auspices of the Department of Defense, but with