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REPORT TO THE CONGRESS

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Benefits And Drawbacks Of U.S. Participation In Military Cooperative Research And Development Programs With Allied Countries

B-167034

Department of Defense

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-167034

To the President of the Senate and the
Speaker of the House of Representatives

We are reporting on the benefits and drawbacks of participating in international cooperative research and development programs.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretaries of the Army, Navy, and Air Force.

R. F. Keller

Acting Comptroller General
of the United States

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ABBREVIATIONS

DOD Department of Defense

GAO General Accounting Office

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D I G E S T

WHY THE SURVEY WAS MADE

GAO studied cooperative military research and development by the United States and one or more allied countries to

--determine the extent of U.S. participation,

--assess benefits, and

--identify problems.

Basic information

The Department of Defense (DOD) participates in cooperative military research and development programs with allied countries to strengthen military alliances and use free world resources more effectively.

DOD's former Director of Defense Research and Engineering estimated that U.S. allies spend about $3 billion annually for military research and development and that about $1 billion of this amount is in areas where the United States is conducting military research and development.

DOD policy is to restrict cooperation to programs which will satisfy a military need and which will provide the United States with full design and production rights. Programs not adversely affecting the U.S. balance of payments are preferred.

FINDINGS AND CONCLUSIONS

Extent of DOD participation

As of September 30, 1973, there were 21 ongoing programs with a total U.S. investment of $172.1 million. There were another eight ongoing small programs for which the extent of U.S. investment could not be determined because agency records were incomplete. In addition, GAO identified 15 programs that had been terminated; U.S. investment in these ranged from $30,000 to about $523.7 million. (See pp. 7 and 8.)

Descriptions and particulars of ongoing and past programs appear in appendixes I and II.

International cooperative research and development is only partially visible in military budgets. Large programs identified as cooperative programs are commingled with all other research and development programs. Small programs, particularly in basic research and exploratory development, are not broken out of broader budget-reporting elements and are not visible as international programs.

There is no single place where all

international cooperative activity is summarized. (See p. 8.)

Advantages of international participation

By pooling economic and technical resources, allied nations can obtain needed equipment and technology at a lower cost and can have access to unique geographical features of other countries.

Primary incentives for participating in international cooperative research and development may be economic. By teaming up with other countries who share in the development cost, DOD can provide its forces with equipment it needs at a lower cost.

The side-looking airborne radar and the fuel cell research programs are two examples. On the radar program, Germany is contributing $12 million, 50 percent of the total cost. On the fuel cell research program, the savings to the United States, represented by the United Kingdom's share, is $379,200. (See pp. 10 and 11.)

DOD is looking to foreign scientific talent and technical expertise to fill gaps in U.S. research and development. In such areas as armored vehicles, shallow-water acoustic research, and forward area air defense, European technological ability is regarded as being equal to or better than that of the United States.

By entering into cooperative programs in one of these areas, DOD can avoid costly duplication. By cooperating with the Federal Republic of Germany in the shallow-water research programs, for example, DOD is getting valuable information not otherwise available because the Navy has concentrated on deep-water acoustical research. (See pp. 11 to 14.)

Often, DOD must develop a piece of equipment that will operate in all types of environmental and geographical conditions. Participation in international cooperative programs may provide the United States with access to unique geographical features not otherwise available. Two such programs are polar cap III and the Azores fixed acoustic range. (See pp. 14 and 15.)

Problems of cooperative research and development

A number of formidable problems, such as those listed below, must be resolved before an international cooperative research and development program can start.

--Adverse balance-of-payments effects. (See pp. 16 to 19.)

--Increased unemployment. (See pp. 19 to 21.)

--Differences in military equipment requirements. (See pp. 21 and 22.)

--Differences in coproduction policies. (See p. 22.)

--Differences in national standards. (See pp. 23 and 24.)

--Military security restrictions. (See p. 24.)

--Lack of resources. (See p. 25.)

--Reluctance to cooperate. (See pp. 25 and 26.)

Other methods of capitalizing on foreign developments

DOD can achieve its goals for international cooperative research and development through three other methods, each having benefits and drawbacks.

Interdependent research and development offers cost, technical, and standardization benefits. In an interdependent research and development agreement, all research and development is funded unilaterally and done by one nation with the end product available to all partners under a licensing agreement. However, interdependent research and development is subject to the same problems as those of cooperative programs. (See pp. 27 and 28.)

Licensing for production of existing foreign equipment in the United States is a means by which DOD can (1) pay a part of the development cost through royalties, (2) put the equipment in service sooner than if duplicate unilateral development were undertaken, and (3) reduce risk because performance is known. Paying royalties, however, would adversely affect the U.S. balance of payments. (See pp. 28 to 30.)

Purchasing foreign-made equipment is not attractive because of the significant adverse effect on the U.S. balance of payments and employment base. (See p. 30.)

Conclusions

The future for international cooperative research and development appears much more promising for basic research and exploratory development programs than for engineering development programs. The obstacles confronting engineering development programs are many and formidable. GAO believes, therefore, that successful engineering development programs, especially those involving the development of major weapon systems, are likely to be few. The obstacles confronting basic research and exploratory development programs appear to be far fewer.

Because DOD can realize favorable cost and technical results, it should continue to emphasize licensing U.S. production of existing foreign equipment which will meet firm U.S. requirements. Obstacles to this licensing do not seem to be insurmountable.

All significant international cooperative research and development programs should be individually identified and summarized as a whole so that they can be fully recognized and properly evaluated. (See pp. 34 and 35.)

RECOMMENDATION

DOD should prepare a formal, annual summary of international cooperative programs and submit it to the Congress with the budget. The summary should identify all significant programs and indicate the estimated cost, development category, and benefits of each. (See p. 35.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

DOD agrees with this recommendation. (See app. III.)

MATTERS FOR CONSIDERATION BY THE CONGRESS

During budgetary hearings in recent years, Congressmen have raised questions concerning the progress, problems, and value of major internation cooperative programs. They also have expressed interest in having DOD take advantage of foreign research and development.

This report should therefore be useful to the Congress in its deliberations on international cooperative research and development programs.

CHAPTER 1

INTRODUCTION

Department of Defense (DOD) policies regulating international cooperative research and development provide for maximum coordination of U.S. technical objectives and programs with those of our allies. The purpose is to strengthen military alliances and to better use free world technical and economic resources made available for military purposes.

In international cooperative research and development programs, the United States and one or more of its allies join together to fulfill a common requirement, sharing cost and effort in predetermined ratios with each participant receiving full rights to the program results. These programs are also called joint international research and development programs.

A responsible DOD official stated that the international cooperative research and development policies also extend to programs in which the United States acquires design rights to foreign equipment. These are called interdependent research and development programs and are defined in greater detail on pages 27 and 28.

The policies provide for U.S. participation in cooperative research and development only when it is in the overall best interests of the United States. The principal goals contained in DOD Directive 3100.3 are as follows:

1. To make the best equipment available to the United States and its allies as quickly as possible.

2. To increase the effectiveness of the scientific and technical resources of the United States and its allies, especially by eliminating unnecessary and wasteful duplicated effort.

3. To standardize equipment as much as possible.

4. To create closer military ties among the allies.

The policies restrict cooperation to those programs which satisfy a military need and provide the United States with design and production rights equivalent to those secured from domestic sources. Moreover, preference is to be given to programs not adversely affecting the U.S. balance of payments.

DOD policies on international cooperative research and development agree with the President's national policy pronouncements. In his February 9, 1972, report to the Congress, the President outlined the basic principles of the new American foreign policy. In emphasizing partnership and cooperation in research and development, the President stated:

> "The unprecedented advances in science and technology have created a new dimension of international life. The global community faces a series of urgent problems and opportunities which transcend all geographic and ideological borders. It is the distinguishing characteristic of these issues that their solution requires international cooperation on the broadest scale."

The Secretary of Defense, in his annual report on the fiscal year 1973 budget, stressed the need for partnership and burden sharing with our allies as part of an overall strategy of "realistic deterrence."

The Congress too has shown a keen interest in international cooperative effort. During budgetary hearings in recent years, Congressmen have questioned the value of international cooperative programs and have expressed interest in having DOD take advantage of foreign research and development.

CHAPTER 2

DOD INVOLVEMENT IN INTERNATIONAL

COOPERATIVE RESEARCH AND DEVELOPMENT

Since September 1963, when present policies came into being, DOD has initiated international cooperative programs in all four categories of research and development. The first three categories--research, exploratory development, and advanced development--deal with advancing technology. The fourth category--engineering development--deals with the development of equipment meeting specific operating requirements and incorporating the latest technological advances.

Some international cooperative programs have been multilateral; however, most have been bilateral. Nearly all the programs have been with other members of the North Atlantic Treaty Organization (NATO).

EXTENT OF INVOLVEMENT

As of September 30, 1973, there were 29 ongoing international cooperative programs involving the United States and 12 other countries. Details about each program appear in appendix I. The table below summarizes 21 of the programs.

Research and development category	Number of programs	U.S. investment
		(millions)
Engineering development	5	$116.8
Advanced development	8	51.1
Exploratory development	4	1.1
Basic research	2	.6
Other (note a)	2	2.5
Total	[b]21	$172.1

[a]The category was not clearly defined for these two programs.

[b]The eight ongoing programs not included were relatively small programs in the basic research and exploratory development categories.

Existing agency records generally do not identify international cooperative programs started and ended before September 1973. By various means we were able to identify 15 past programs. The U.S. investment in these programs ranged from $30,000 for an exploratory development program to $523.7 million for an engineering development program. Details about each program appear in appendix II.

VISIBILITY IN MILITARY BUDGETS

International cooperative research and development is not fully visible in military budgets. Large programs, which generally are identified as international cooperative programs, are commingled with all other research and development programs. Small programs, particularly those in basic research and exploratory development, are not broken out of broader budget-reporting elements and thus are not visible as international programs. Moreover, there is no single place where all international cooperative activity is summarized.

TRENDS

Because we could not identify all past programs--particularly small ones--we could not demonstrate trends. Available data showed only that overall DOD participation in international cooperative programs had been relatively low compared to the total DOD research and development budget.

Opinions expressed by DOD officials varied and did not clearly indicate trends. An official responsible for international research and development programs in the Office of the Director of Defense Research and Engineering said that top-level interest since 1970 had shifted from cooperative research and development (joint programs) to licensing foreign equipment.

The official attributed this shift to the lack of success with international cooperative research and development programs in the past. He said, however, that international cooperative research and development would continue at the low level and that cooperative programs would be started from time to time.

Navy and Air Force officials responsible for international research and development programs felt international cooperative research and development as a whole was likely to increase. The responsible Air Force and Army officials felt there might be a future trend away from major weapons and toward small items of equipment, components, and exploratory-type development.

Although past participation has been minimal, there are indications that there is future potential for increased international cooperative research and development. The cost and complexity of equipment continue to increase, military budgets may be stabilized or cut, foreign policy is inclining more toward international cooperation, and much effort is being duplicated among allies. The Director, Defense Research and Engineering, estimates that our allies are spending about $3 billion yearly for research and development and that, of this amount, about $1 billion is in areas in which the United States is also conducting military research and development. In 1971 NATO headquarters made a requirements review and compiled a list of areas for future cooperation.

Therefore, it appears all the more important to weigh the advantages and disadvantages of international cooperative research and development and find the best ways to capitalize on the capabilities and efforts of our allies.

CHAPTER 3

ADVANTAGES OF INTERNATIONAL

COOPERATIVE RESEARCH AND DEVELOPMENT

Bilateral and multilateral international cooperative research and development programs offer many advantages over unilateral programs. By pooling economic and technical resources, nations can obtain needed equipment and technology at lower costs and can have access to technical advances and unique geographical features in other nations. Cooperative research and development, if successful on a large scale, may be a means of reducing duplicated equipment and technology among allies and standardizing equipment.

Limited DOD experience has demonstrated the benefits which can accrue from international cooperative research and development.

COST BENEFITS

A primary incentive for becoming involved in a bilateral or multilateral international cooperative program may be economic gain. By teaming up with other countries who share in the development cost, DOD can provide its operational forces with equipment they need at a lower cost.

Potential savings are greater for engineering development programs than for programs in other categories because engineering development generally requires large expenditures of economic resources. Examples of cost benefits expected for an engineering development program and an exploratory development program follow.

Side-looking airborne radar

The Air Force expects to reduce its development costs 50 percent by cooperating with the Federal Republic of Germany for advanced and engineering development of a side-looking airborne reconnaissance radar system. (Both countries have a requirement for such a system, and an Air Force official said the United States would have developed the system on its own anyway because of its need.) All the work is being done in the United States, and the cost is being shared equally. Air Force officials indicated that Germany was buying technology and that it was not technically capable of sharing the work.

In November 1973, an Air Force official said the current development program was to be completed in January 1974. The Air Force official said Germany would be invited to participate on the same terms in a follow-on program to incorporate the newest technological advances in the radar system. A better overall system is expected as a result of this work.

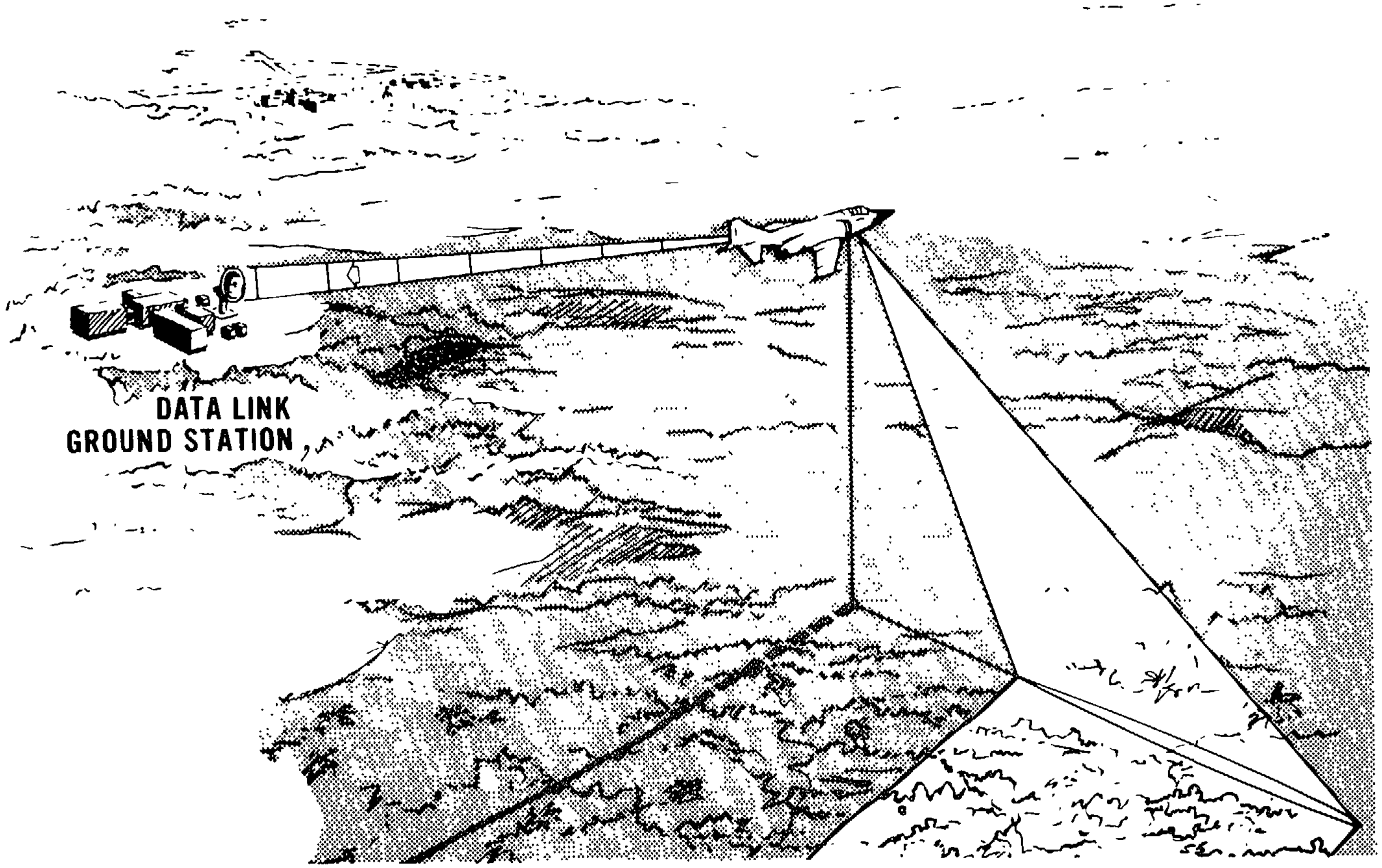
The official said about $24 million would have been spent on the program by January 1974. The United States and Germany will each bear half the costs. Besides realizing a cost savings of $12 million, the United States is benefiting from the employment and balance-of-payments standpoint because all work is being done in the United States.

Fuel cells

The Army expects to gain economically as well as technologically by cooperating with the United Kingdom in exploratory development on fuel cells. A fuel cell generates direct electrical current through the cold chemical reaction between oxygen and hydrogen. The objective of the work is to form a basis for developing efficient, advanced, low-cost electrical power sources. The work has been divided equally, with each country funding its share. Each country has full rights to the results of the work. Potential savings to the United States, as represented by the United Kingdom's share, is $379,200 over a 4-year period.

TECHNICAL BENEFITS

DOD is looking to foreign scientific talent and technical expertise to fill gaps in U.S. research and development. In certain areas, such as forward area air defense, armored vehicles, sonars, metals research, and shallow-water acoustic research, European technological ability is regarded as being equal to or better than our own.



Department of Defense picture.

SIDE-LOOKING AIRBORNE RADAR

The radar will provide all-weather reconnaissance in three-dimensional picture-like presentation with greater aerial coverage.

By entering into an international cooperative research and development program in one of these areas, DOD can avoid costly duplication. Examples follow.

Shallow-water acoustic research program

The Navy's shallow-water acoustic research program with the Federal Republic of Germany and the Netherlands is concerned with gathering basic hydroacoustic data, exploring environmental acoustics of the Baltic Sea, and testing sound propagation in selected areas of the western Baltic Sea. The objective of this program is to expand the U.S. shallow-water research data bank.

The United States has concentrated mainly on deep-water acoustic research and has only one shallow-water range in operation today. Although considerable data and knowledge of shallow-water acoustics has been acquired from this range, the data has been obtained from only one area. By cooperating, the Navy is able to capitalize on important foreign research. The Navy is also attempting to obtain similar agreements with allies in other parts of the world.

Planar array sonar

The Navy has concentrated on increasing the capability of its AN/SQS-26 surface ship sonar system while foregoing unilateral development of a new type of surface ship sonar called the planar array sonar, which differs in operational concept from the existing system.

Although the Navy had an advanced-development requirement for a planar array sonar, it did not elect to proceed on a unilateral development program because of insufficient resources. The United Kingdom was doing advanced development work in the planar array area prior to the agreement to cooperate. To capitalize on the United Kingdom's efforts, the Navy entered into a bilateral advanced-development cooperative program. By doing so, the Navy will obtain rights to designs, concepts, and data needed but not otherwise available. Project officials estimate that the U.S. contribution will be about 25 percent of the cost of the whole program.

The Navy's AN/SQS-26 improvement program and the planar array advanced-development program are both expected to result in greatly improved sonar range and detection capabilities.

ACCESS TO DIFFERENT GEOGRAPHICAL AREAS

The benefits of participating in an international cooperative research and development program cannot be measured in economic and technical terms alone. Often, DOD must develop a piece of equipment that will operate in all types of environmental and geographical conditions. Participation in international cooperative programs may permit the United States to exploit unique geographical features not otherwise available. Two such international cooperative programs are polar cap III and the Azores fixed acoustic range.

Polar cap III

The Air Force and Canada are engaged in this bilateral cooperative research and development program. Basically, the program involves testing over-the-horizon radar at a Canadian site near the North Pole. The tests are to determine the effects of the aurora borealis on the radar's operation. Test data will be used to determine the feasibility of locating over-the-horizon radars in the Arctic regions.

The United States is realizing several benefits from this program because Canada is contributing to the cost of the program and providing the testing site. Otherwise, the site might not be available or the United States would have to pay the full cost of the program in addition to renting the site.

Azores fixed acoustic range

The United States, along with seven other nations, has entered into a multilateral international cooperative research and development program to establish the Azores fixed acoustic range. This facility is for conducting fixed underwater communications experiments.

It is an established fact that voice communication through water is difficult. The Navy wanted to develop data for such a communication system, using the most adverse conditions as a basis and thereby establishing the parameter within which the system would have to operate. The Azores area had the environmental and geographical conditions most desired. As a result, the Navy has gained access to an area that the United States might otherwise have had to rent, or worse, have been denied access to.

CHAPTER 4

PROBLEMS OF INTERNATIONAL

COOPERATIVE RESEARCH AND DEVELOPMENT

Initiating and participating in an international cooperative research and development program is not easy because of various formidable obstacles. Pooling economic and technical resources, a characteristic of cooperative programs, opens the way for the Nation's balance of payments to be adversely affected or its employment base eroded. Moreover, differences among nations' requirements, policies, standards, national security, capabilities, and attitudes are wide and generally irreconcilable. These obstacles not only prevent programs from starting but they also influence the nature and outcome of programs which do start.

BALANCE OF PAYMENTS

International cooperative research and development programs, if indiscriminately undertaken, can adversely affect the balance-of-payments situation--dollars will leave the country. DOD policy provides that preference be given to those programs in which adverse balance-of-payments effects can be minimized or avoided. Some of our allies also appear to take this view regarding their own balance of payments. Thus, balance-of-payments considerations have become a crucial negotiating point in determining cost- and effort-sharing arrangements on cooperative programs and could be an obstacle to starting programs.

Balance-of-payments problems may be minimized to some extent through the offset technique. This involves allocating cost and effort in such a manner that currency outflows balance the inflows. This method was used on two programs. On the NATO Seasparrow ship defense missile program, for example, cost sharing was based on the ratio of each country's projected quantitative requirements. Work was to be allocated, to the extent possible, according to the cost ratio so that adverse balance-of-payments effects would be minimal for all participants. The sharing arrangements included formulas for readjusting development costs to provide for quantity changes.

The prime contractor, an American firm, was to allocate the work by awarding subcontracts to firms in each of the participating countries. A maximum deviation of plus or minus 25 percent from a zero U.S. balance of payments was permitted. In this case, the impact on the balance of payments will not be known until the program is completed.

Balance-of-payments problems can be avoided by dividing the research and development work among participating countries, with each country funding its own work. The final product--experimental results or design and production rights--is fully available to each participant without exchanging funds. It is clear that this type of sharing arrangement will not affect the balance of payments. This was the type of sharing arrangement agreed to for 9 of the 29 ongoing DOD programs. Moreover, this method could be applied to any of the four categories of research and development.

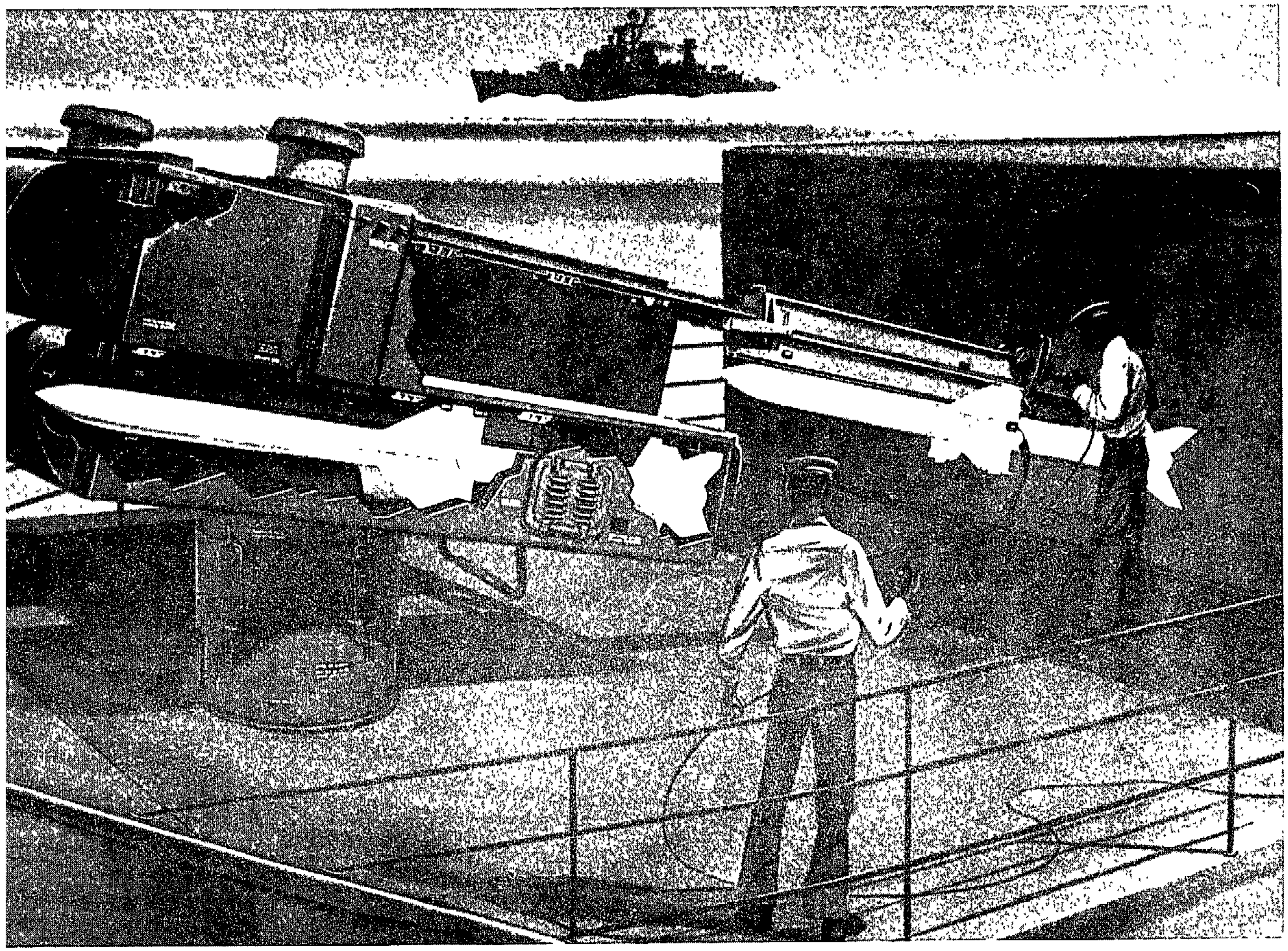
Permissible imbalance

A special foreign policy agreement between the United States and Canada provides for cooperation in research and development and establishes the policies governing the United States-Canadian development-sharing program. The program is to help provide for integrated common defense of the North American Continent and a wider defense mobilization base.

Under this program, the United States pays at least 25 percent of the cost and all work is done in Canada. As of September 30, 1973, DOD had seven cooperative programs under this agreement. For the most part, cost sharing was about 50-50. The total U.S. share for the seven programs was $24.4 million. Since all work is done in Canada, there is an imbalance in favor of Canada; however, the need to provide for a common defense is believed to override U.S. balance-of-payments policies in this case.

Fluctuating currencies

Fluctuations in international monetary exchange rates can cause a redistribution of real burdens and benefits and can affect the balance of payments on programs in which



ure.

NATO SEASPARROW SURFACE-TO-AIR-MISSILE

and launcher. The system is designed to provide ships with a defense capability against high-speed aircraft and antiship missiles.

participants exchange funds. So far, the United States has probably benefited from such fluctuations.

An example is the Javelot forward air defense missile system project between the United States and France. The United States agreed to pay 50 percent of France's development cost. In May 1972, France informally expressed concern about the effects of the U.S. dollar devaluation on the cooperative project. France was apparently concerned because the exchange rate change increased its share of the funding. France apparently had no intention of pushing the point at that time, but it did ask if future U.S. payments for the Javelot project could be increased to adjust for the 8.5-percent devaluation. An Army official told us the sharing arrangements had not changed.

We found no indication that fluctuating exchange rates had been a significant obstacle to successful international cooperative research and development. However, future cooperative agreements may have to provide for adjusting the funding arrangements whenever participants' exchange rates fluctuate.

FEAR OF ERODING THE NATIONAL EMPLOYMENT BASE

Because much of the research and development work for the cooperative programs is done outside the United States, it could be argued that such programs lead to substantial U.S. unemployment, assuming that the expenditure of Federal funds is directly related to the creation of jobs. If cost-sharing arrangements permit an adverse balance of payments, unemployment in the United States could result. If cost-sharing arrangements have no effect on the balance of payments, employment would not be affected. Employment is not affected when work is split among participating countries with each country paying only for its own work.

To minimize the erosion of the national employment base, DOD follows a policy of (1) giving preference to cooperative research and development programs not involving coproduction and (2) obtaining full design and production rights on all cooperative programs so that production may be carried out fully within the United States. As discussed later in this report (see p. 22), DOD generally cannot get engineering development-type cooperative programs started unless it agrees to coproduce.

Under coproduction agreements the participants each produce some component of the weapon system. On the NATO Seasparrow program, for example, the United States produces the missile and major portions of the fire control and launcher subsystems and assembles the total system; Norway produces the computer; Denmark produces the pedestal for the launcher; and the remaining countries produce other portions of the system.

Buy American

Various measures, including the Buy American Act (41 U.S.C. 10a), have been adopted to protect the domestic employment base. The Buy American Act is concerned primarily with restricting the acquisition of foreign goods and supplies. DOD has applied similar restrictions to purchases of foreign services. Our report to the Congress entitled "Coordinated Consideration Needed of Buy National Procurement Program Policies," dated December 9, 1971, discusses the Buy American policies in greater detail.

Contrary to what might be supposed, the Buy American restrictions do not preclude all DOD purchases abroad. If the foreign content of an end-item is less than 50 percent of its value, it is considered a domestic end-item and no restrictions apply; moreover, the Secretary of Defense is permitted to waive the restrictions if national security considerations require it. Because DOD does not keep records which identify programs not started because of Buy American restrictions, we could not determine whether the Buy American restrictions had been an obstacle to international cooperative research and development.

Department of Defense Appropriation Act

The fiscal year 1973 Department of Defense Appropriation Act (Public Law 92-570) bars DOD from spending research and development dollars abroad when a United States company can do the same work at a lower cost. A responsible DOD official said his office had reviewed past and ongoing programs to see what effect this would have had on cooperative research and development. He concluded that there would have been no effect.

DIFFERENCES IN MILITARY EQUIPMENT REQUIREMENTS

According to a contractor study,[1] nations' inability to harmonize their requirements is a major obstacle to international cooperative research and development.

For example, the United States may require sophisticated multirole equipment for its wider, global responsibilities, whereas our allies may need austere single-purpose equipment for their local scenarios.

Harmonizing requirements appears to be a problem solely in engineering development programs, for which there are specific performance parameters. To agree on mutual requirements for a cooperative development program, each potential participant must make compromises in individual requirements. This can cause a problem. If a compromise is not possible, then a cooperative program is not initiated, and the potential participants go their separate ways, each involved in costly development programs.

Because records were not readily available on cooperative programs considered but not started, we could not determine the extent that candidate programs were rejected because of nations' inability to harmonize requirements. We did, however, find some examples. One prospective program where harmonizing was a problem was the mechanized infantry combat vehicle program. According to an Army document, the interested countries could not, for example, agree on whether the vehicle would have a swimming or a fording capability. Therefore, the United Kingdom, France, the Federal Republic of Germany, and the United States each

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[1]"The Potential For Anglo-American Cooperation in the Field of Transportation Technology," by Allied Systems Limited, London, England, dated June 1971. This study was contracted for and funded jointly by the U.S. Department of Transportation and the United Kingdom's Ministry of Transport. The study included a detailed analysis of joint defense research and development programs within NATO.

developed a vehicle to meet its own specific requirements.

In the case of the main battle tank (MBT-70) program, a bilateral engineering development effort involving the United States and the Federal Republic of Germany, harmonizing was a problem before and after the program started. Therefore, the cooperative agreement provided for a degree of commonality with each country having a different version, the U.S. version being more sophisticated. As development proceeded, several amendments were made to the cooperative agreement, each change resulting in less commonality. Finally, the United States pulled out of the cooperative program, and 2 years later the U.S. program was terminated under claims that the MBT-70 was overly sophisticated and unnecessarily complex.

To meet its requirement for a main battle tank, the Federal Republic of Germany used developments generated in the joint program to develop the Leopard II, which is far less complex than the MBT-70. Germany is planning to sell the tank to several European countries. The U.S. Army still plans to develop a sophisticated main battle tank.

DIFFERENCES IN COPRODUCTION POLICIES

Differences in coproduction policies are also a major obstacle to international cooperative research and development. To the allies, cooperative research and development goes hand in hand with cooperative production. In European cooperative programs, development and production costs and markets are shared. As indicated earlier, DOD prefers not to combine coproduction with codevelopment because of domestic employment considerations.

In the past the United States, for the most part, has not been able to get a cooperative program started on engineering development involving large systems unless coproduction has been part of the agreement. This was true of Project Mallard, the XJ-99 vertical takeoff engine, the NATO Seasparrow, and the NATO hydrofoil fast patrol boat.

DIFFERENCES IN NATIONAL STANDARDS

The United States uses the English system of weights and measures, whereas our allies and most other countries in the world use the metric system. Moreover, there are differences in national standards for materials such as sheet metal, plate, wire, and electronic components. Likewise, standards for engineering drawings differ. These differences can pose intricate problems for international cooperative development programs.

When a system's components are developed by countries having different standards, interoperability problems may occur. Components developed according to one standard may not interface with components developed by another nation according to a different standard. This caused major problems on the MBT-70 program, one of which involved thread fasteners produced under different standards. It was finally agreed that, in producing the fasteners, the United States would use the inch standard and Germany the metric; both countries would use the metric standard for parts that were to interface.

If DOD accepts equipment wholly or partially made up of components and parts made to metric standards, it might be confronted with a costly support and maintenance problem. Spare parts and bits and pieces, such as screws and wires, might have to be produced in the United States in uneconomical lots according to the metric system or purchased abroad. Standardized English system tools and testing equipment, moreover, might not be capable of testing and repairing metric system hardware, and thus additional support for metric hardware might be required.

Officials responsible for the NATO hydrofoil fast patrol boat program stated that the participants were having problems deciding on whether to use the metric system, the English system, or both. This took several months to resolve. Finally they decided to use a mixture of the two. This was partly because some of the already developed components were made according to the metric system and some according to the English system.

We believe that mixing metric with English standards in developing equipment might lead to additional problems if the equipment is to be wholly produced by each of the participants. U.S. manufacturers geared to the English system would have difficulty producing components designed according to the metric system. Moreover, components might be costly to maintain and support.

Differences in standards appear to be a problem only in engineering development programs, in which military hardware is being developed for service use.

Differences in standards might be a lesser problem if and when the United States converts to the metric system. Plans are being made for voluntary conversion to the metric system. There are also several bills now being considered in the Congress, (for example, H.R.11035). The proposed conversion would take place over a 10-year period.

DIFFICULTY ASSOCIATED WITH MILITARY SECURITY

Military security restrictions may limit international cooperative research and development among the allies in certain defense areas. Within the United States, participation in an international cooperative research and development program in the defense area must operate within military security limits and national disclosure policies. As a result, the United States has refused to disclose information on various national developments to its allies. This has brought reciprocal action from the allies in areas of interest to the United States.

The United States is reluctant to share technical and scientific knowledge of strategic weapons, such as those involved in undersea warfare. The United States has been involved in a national development effort for a new, highly sophisticated, wire-guided torpedo. A responsible project official stated that one European country requested information on this developmental effort but was refused because of security restrictions. In apparent retaliation, the United States was refused information on torpedo developments by that country.

AVAILABILITY OF RESOURCES

Only a few nations have the economic and technological capabilities to unilaterally develop today's costly weapon systems. Participation in an international cooperative program offers the only opportunity for small nations with limited resources to increase their technological base and develop needed hardware. Norway, for example, wants to advance its military research and development capability but cannot bear the costs and risks alone. Norway thus views bilateral and multilateral cooperative development programs as a necessity to achieve its goals. Large nations, however, may not want to cooperate with the small nations that may not have anything to offer.

Although the lack of technological expertise may not preclude a nation's participation, a shortage of money will. This can apply to large as well as small countries. Two examples of this exist in the NATO Seasparrow and the NATO hydrofoil programs. In both programs many interested nations did not participate because they lacked money. More specifically, a study showed that Portugal was interested in the Seasparrow program but did not participate because of budgetary problems. We were informed that the United Kingdom and Canada failed to participate in the hydrofoil program because of several reasons, of which budgetary problems was one.

WILLINGNESS TO COOPERATE

The United States and its allies appear to have different motives for participating in international cooperative research and development programs. To the United States, such programs are a means of reducing development costs, achieving standardization, avoiding costly duplication, and exploiting the benefits its foreign allies have to offer. The allies view such programs as a means of avoiding an unsupportable cost burden and increasing their sales and profits. Eliminating duplication and achieving standardization are not as important as they are to the United States.

Independent[1] and in-house[2] studies conclude that nations' willingness to participate is an intangible factor inhibiting international cooperative research and development. It is the consensus of these studies that the European community views cooperative programs as a necessity to be able to afford large, expensive programs. In contrast, the United States views cooperative programs as a desirable goal but not a necessity. Thus, European countries are felt to be more willing to cooperate.

The reluctance to cooperate is sometimes attributable to the "not wanted here" syndrome or the "not invented here" syndrome. Both follow the same basic theme. No matter what foreigners develop, it is not considered by some as good as ours. Likewise, we do not want to depend on a foreign supplier--we need a domestic source of supply. These syndromes have been, and continue to be, a big problem although there has been some improvement in recent years, according to DOD officials. They said that exposure to foreign equipment will help to further alleviate the situation.

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[1]"The Potential For Anglo-American Cooperation in the Field of Transportation Technology," by Allied Systems Limited, London, England, dated June 1971. This study was contracted for and funded jointly by the U.S. Department of Transportation and the United Kingdom's Ministry of Transport. The study included a detailed analysis of joint defense research and development programs within NATO.

[2]"An Assessment of NATO Naval Research and Development," staff study, dated November 8, 1967, by the Office of Naval Research.

CHAPTER 5

OTHER METHODS OF CAPITALIZING ON FOREIGN DEVELOPMENTS

Some DOD goals for international cooperative programs can be achieved by obtaining equipment developed by foreign countries. The three most apparent methods of obtaining this equipment are:

1. Interdependent research and development programs.

2. Licensing agreements with foreign developers.

3. Direct procurement of foreign hardware.

Each of these methods can be considered a form of cooperative research and development in the sense that the United States benefits technically and pays only part of the development cost. The three methods differ from joint international programs in that the United States has no control over development, does not share in the development work, and pays the development costs indirectly. The benefits and drawbacks of each method are discussed below.

INTERDEPENDENT RESEARCH AND DEVELOPMENT

Interdependent specialization among allies in military research and development appears to be economically attractive. In an interdependent research and development agreement, all research and development work is unilaterally funded and done by one nation, with the end product available to all partners under a licensing agreement. Thus, wasteful duplication of research and development among allies is eliminated and each country obtains more for the resources it spends. Also, having one nation fulfill management responsibilities allows the program to proceed faster and more cheaply. Under the license, each country pays for only part of the research and development costs. The success of interdependent research and development, however, apparently hinges on overcoming various formidable obstacles.

As discussed in chapter 4, harmonizing differences in requirements and differences in national standards is a major obstacle to successful cooperative development. If nations cannot harmonize requirements for cooperative research and development programs, we do not see why they would harmonize requirements for interdependent research and development. Moreover, differences in national standards would still exist under interdependent research and development. Although interoperability problems might not be a factor because one country would be developing all the components of a system, there might be problems when a nation tried to manufacture a system designed under different standards.

Finally, no military services, especially those of the United States, would rely exclusively on foreigners for developing crucial equipment.

LICENSING AGREEMENTS WITH FOREIGN DEVELOPERS

Licensing is a means of establishing a domestic source for a piece of foreign hardware. Under licensing agreements, foreign developers provide the data package, patent rights, technical assistance, and whatever else is needed to enable the domestic source to produce the desired hardware. In return, the domestic source compensates the foreign developer through royalties or a license fee.

The difference between interdependent research and development agreements and licensing agreements is that under the latter there is no attempt at harmonizing requirements when the program starts. The country developing the equipment designs it for its own needs and apparently it is only a matter of chance that the equipment meets U.S. needs. Under an interdependent arrangement, the two countries harmonize their requirements before development starts.

Licensing foreign equipment has many of the advantages and some of the disadvantages which face international cooperative research and development programs. The obstacles to success, however, are not nearly as great.

By obtaining production rights to existing foreign equipment, a country pays only part of the development costs and puts the equipment in use sooner than if unilateral duplicate development were undertaken. Since the equipment already exists, performance is known and normal developmental risks can be avoided. Moreover, U.S. technicians can learn the foreign technologies incorporated in the foreign equipment by producing the equipment.

The former Secretary of Defense and the former Director of Defense Research and Engineering began to promote the licensing of foreign equipment in 1970. U.S. corporations reacted to this new environment by taking the initiative and obtaining licensing agreements for production of several complex foreign weapon systems. Most notable are the French Exocet antishipping missile, the British Rapier, the French Crotale air defense missile system, the French-German Roland air defense missile system, and the Italian 76 mm Oto Melara automatic gun.

Regarding the U.S. Army's low-altitude forward area air defense system requirement, the Army is evaluating the Crotale, Rapier, and Roland. Pictures of these systems appear at the end of this chapter. The Crotale is operational, the Rapier is in production, Roland I is being readied for production, and Roland II is in advanced development. By contrast, the United States does not have a system in development in this same category. The Army estimates that developing such a system on its own would take 8 years and cost about $250 million to $500 million. Through licensing, the system can be made available now at a fraction of this cost.

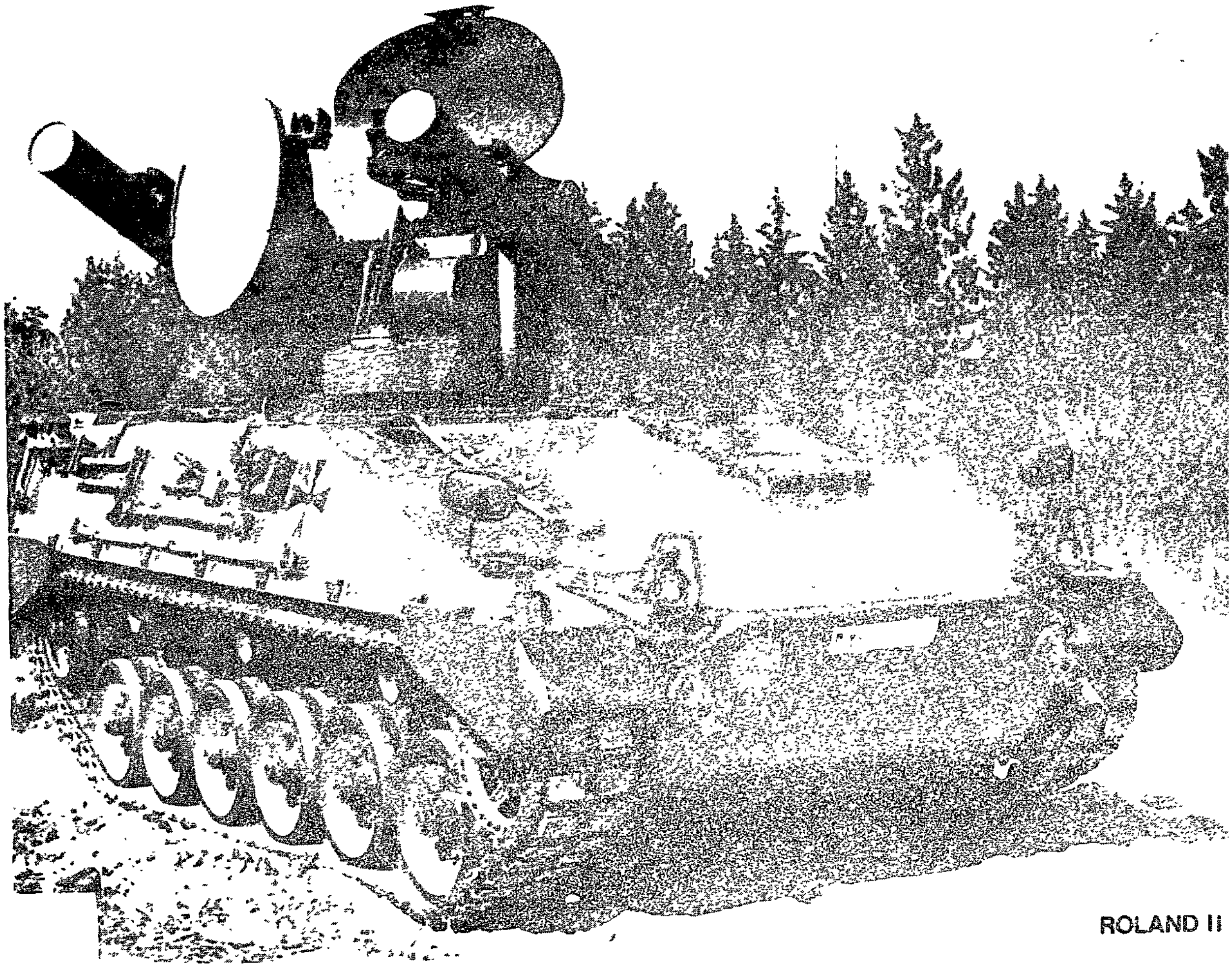
A responsible DOD official stated that foreign licensing would expand the U.S. employment base. He explained that mass production involving greater numbers of workers could be undertaken sooner and that funds which normally would have been applied to a unilateral development program would be applied to other developmental efforts.

Adverse effects on the balance of payments, military resistance to using foreign equipment, and differences in standards appear to be the main obstacles to licensing foreign equipment. Since the United States is buying the rights to produce without any inflow of funds to offset the outflow, it follows that the balance of payments will be affected to some extent; the military services, in some cases, may be unwilling to accept foreign equipment; and, although differences in national standards may not be an interoperability problem as they are in cooperative research and development, they could become a problem when U.S. firms geared to the English system try to produce something designed to metric standards. The degree to which these problems would be tolerated would apparently depend on the benefits to be received in technical, economic, and availability terms.

DIRECT PROCUREMENT OF FOREIGN HARDWARE

Direct procurement of foreign hardware offers advantages similar to those of licensing agreements. These advantages include eliminating costly duplication, achieving standardization, and introducing new equipment more quickly. Likewise, the United States could take advantage of lower unit costs for foreign items.

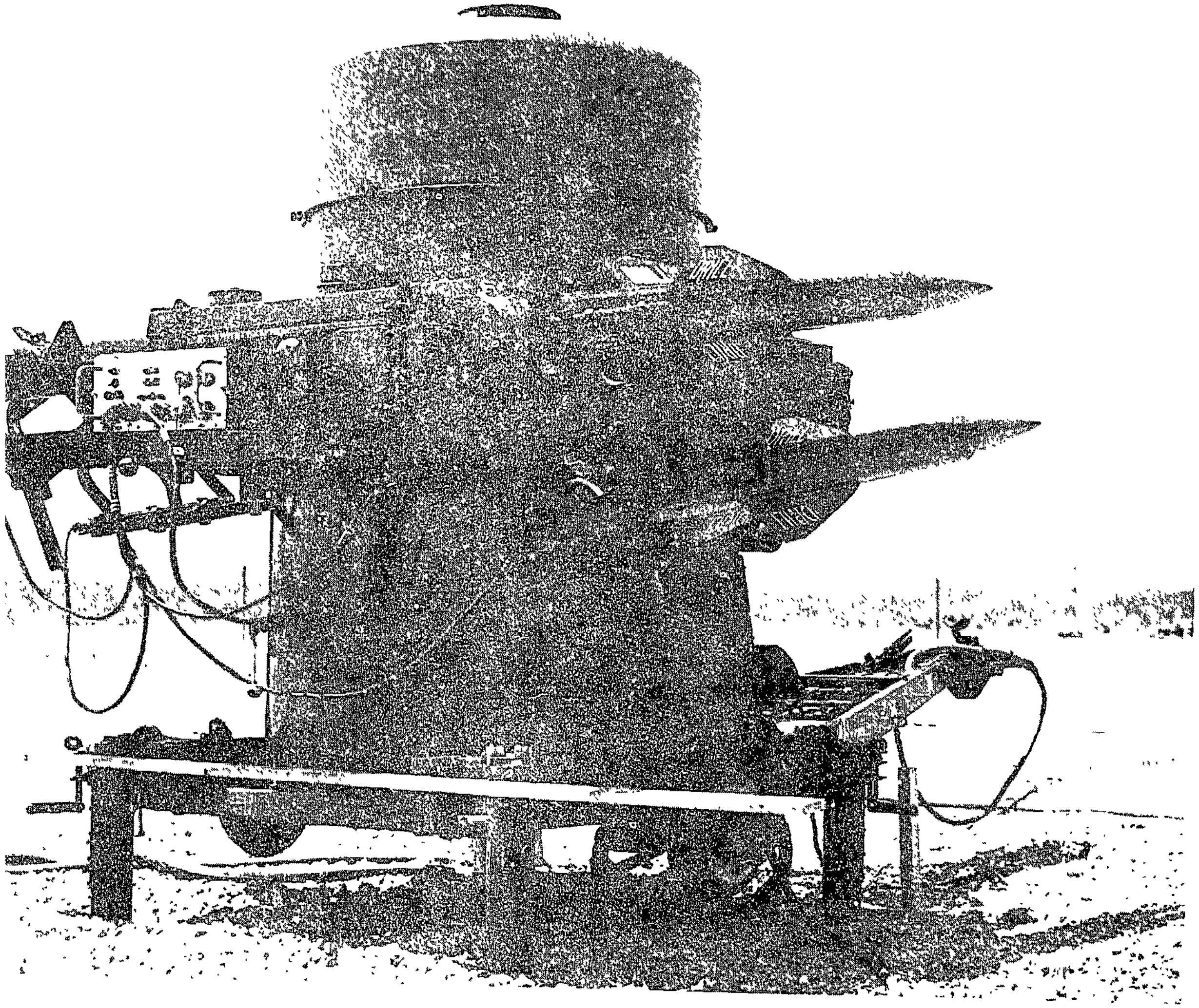
Although direct foreign procurement offers some attractive advantages, there are inherent disadvantages which we believe would preclude using this method to any great extent. The balance of payments would be adversely affected, the domestic employment base would be eroded, and the military services would have to rely exclusively on a foreign supplier for spare-parts support.



Department of Defense picture.

ROLAND II

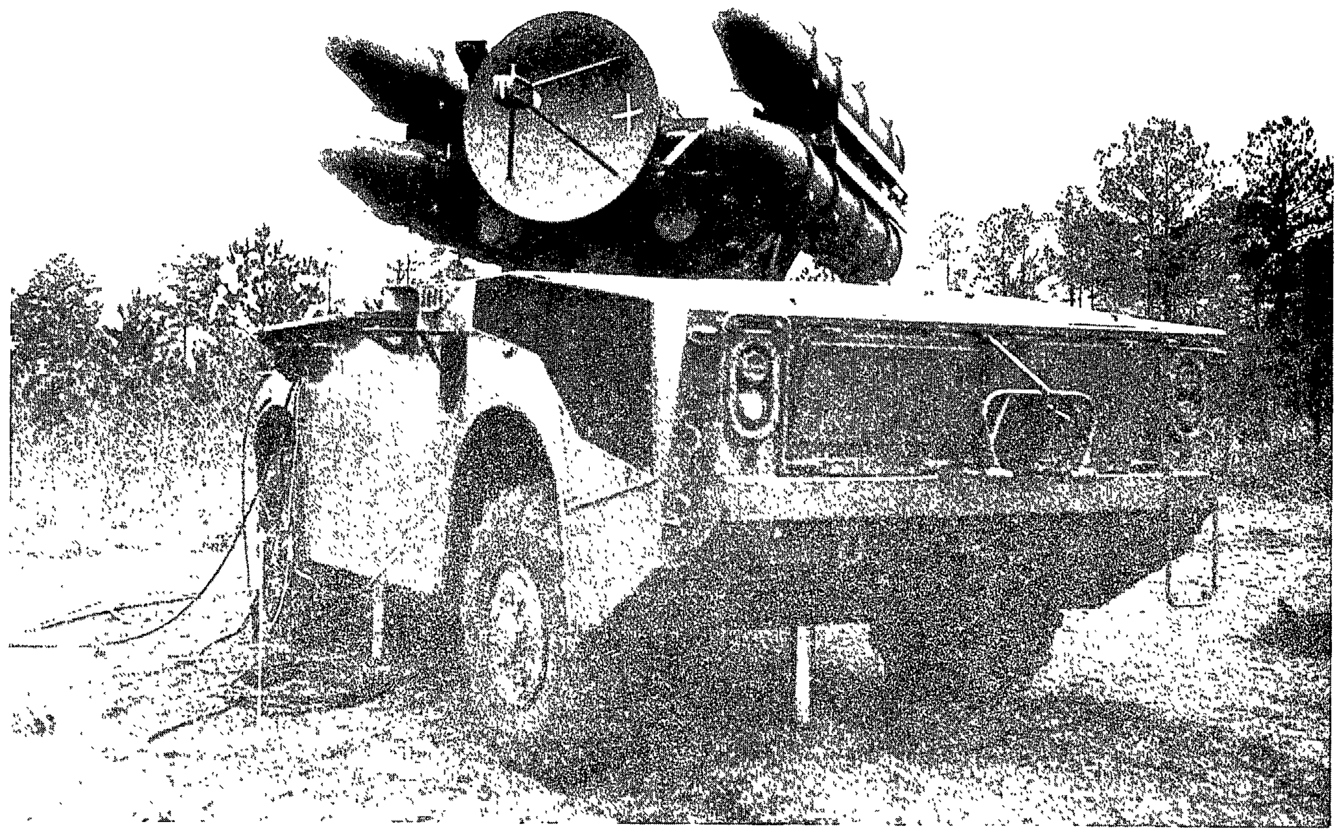
The ROLAND is a joint French-German system designed to provide a defense against low-level aircraft and missiles.



t of Defense picture.

RAPIER

is a British-developed system designed to provide a defense against low-level aircraft. Picture shows the launcher portion of the system.



Department of Defense picture.

CROTALE

The CROTALE is a French-developed system designed to provide a defense against low-level aircraft. Picture shows the missile and launcher portion of the system.

CHAPTER 6

CONCLUSIONS, RECOMMENDATION, AND AGENCY COMMENTS

CONCLUSIONS

The future for international cooperative research and development appears much more promising for basic research and exploratory development programs than for engineering development programs.

The obstacles confronting acceptance of candidate engineering development programs are many and formidable. The wide differences between the United States and its allies in requirements, policies, capabilities, attitudes, standards, and security are not controllable by DOD and generally are not reconcilable.

We believe, therefore, that successful engineering development programs, especially those involving the development of major weapon systems, are likely to be few. When special circumstances permit, as with the side-looking radar and the Seasparrow missile system, engineering development of major systems may take place.

Without many engineering development programs and widespread participation or acceptance, a major goal of cooperative research and development--eliminating wasteful duplication of equipment among allies--will not be met to any appreciable extent. The benefits of standardization, therefore, will also be negligible.

The future for international cooperative research and development appears much more promising for programs in the earlier stages of development, especially in basic research and exploratory development. Adverse balance-of-payments effects can be avoided by using proper cost- and work-sharing arrangements. Concern about adverse effects on the employment base, moreover, may be insignificant since few resources generally are used in such efforts. Other obstacles, for the most part, are not deterring factors since the end product is information or equipment concepts rather than military hardware. We therefore believe the potential for cooperation is greater for research and exploratory development programs.

We also believe the current DOD emphasis on licensing existing foreign equipment is desirable because of the favorable cost and technical results that can be achieved. Obstacles to this licensing do not seem to be insurmountable. There is no need to harmonize requirements. Manufacturing the equipment according to different standards may pose some problems, but the interoperability of components designed by two or more countries with different standards will not.

Because of current national concern over military involvement with foreign powers, we believe international military activity should be fully visible. To this extent, all significant international cooperative research and development programs should be individually identified and summarized as a whole so that all activity will be visible and can be properly evaluated. At present this is not done.

RECOMMENDATION

We recommend that DOD prepare an annual formal summary of international cooperative activity to be submitted to the Congress with the budget. The summary should identify all significant programs and indicate their estimated cost, development category, and benefits.

AGENCY COMMENTS

DOD agreed with our findings and concurred with our recommendation. (See app. III.)

CHAPTER 7

SCOPE OF REVIEW

In the light of attention being given to international military cooperation and in the absence of prior GAO reviews in the area, we made this study to determine the degree of U.S. involvement in international cooperative research and development, assess the benefits, and identify the problems.

We analyzed policy directives, instructions, cooperative agreements, development plans, requirement documents, memorandums, technical reports, trip reports, pertinent articles, contract files, and related study reports.

We did our work primarily within the Office of the Chief of Naval Operations; Headquarters, Army Materiel Command; Headquarters, Air Force Systems Command; and various subordinate developing activities and project offices. We also talked to responsible officials at the Office of the Director of Defense Research and Engineering and at Headquarters, Departments of the Army, Navy, and Air Force. We did not visit overseas or U.S. locations where international cooperative research and development programs were being carried out.

Information in the report concerning individual programs was generally obtained from headquarters groups and in many instances from program officials. We did not make a detailed review of individual projects.

ONGOING INTERNATIONAL COOPERATIVE RESEARCH AND DEVELOPMENT PROGRAMS

SEPTEMBER 30, 1973

Program title	Effective starting date	Estimated completion date	Foreign participants	Military service	U.S. share of research and development costs Amount	Percent
Engineering development:						
NATO hydrofoil fast patrol ship (note a)	(b)	June 1975	Federal Republic of Germany, Italy	Navy	$75,900,000	71.0
NATO Seasparrow surface missile system (note a)	June 1968	Feb. 1976	Belgium, the Netherlands, Italy, Norway, Denmark	Navy	29,314,000	83.6
Side-looking airborne radar improvement program (note c)	Dec. 1968	Jan. 1974	Federal Republic of Germany	Air Force	12,000,000	50.0
Band IV headset for GRC-130 radio relay set (note a)	Mar. 1971	Feb. 1979	Canada	Army	[d]1,500,000	[d]50.0
Meteorological research, development, test, and evaluation rocket vehicle and associated equipment	Aug. 1966	June 1974	Canada	Army	1,109,387	42.4
Advanced development:						
Reliable acoustic path sonar	Mar. 1972	Mar. 1977	France	Navy	(e)	[d]20.0
Planar array sonar	Sept. 1968	Jan. 1976	United Kingdom	Navy	(e)	[d]25.0
Polar cap III (note f)	Mar. 1972	Dec. 1974	Canada	Air Force	[d]8,000,000	[d]89.0
Javelot weapon system	Apr. 1971	Apr. 1976	France	Army	1,351,000	50.0
Aircraft air-cushion landing system	May 1971	Nov. 1975	Canada	Air Force	6,900,000	55.2
Tactical aircraft guidance system	Dec. 1968	Jan. 1974	Canada	Army	14,070,000	60.0
Recording radiation monitor and automatic radiation alarm system	Dec. 1971	May 1977	Canada	Army	[d]225,000	[d]50.0
Individual (personal) radiation dosimeter and reader	May 1973	May 1975	United Kingdom	Army	300,000	50.0
Exploratory development:						
Plasma research	Sept. 1966	June 1974	Italy	Air Force	179,000	31.0
Analytic photogrammetry	Feb. 1965	Continuing	Italy	Air Force	221,700	60.0
Gas and aerosol cloud diffusion studies	Aug. 1967	Jan. 1974	Norway	Army	100,000	39.0
Fuel cell research	Nov. 1968	Nov. 1974	United Kingdom	Army	640,000	63.0
Chemical agent alarms	Mar. 1971	July 1974	United Kingdom	Army	(g)	-
Lightweight steel armor and aluminum alloy	July 1971	Sept. 1974	United Kingdom	Army	[h]27 man-years	50.0
Fragmenting mechanisms in naturally fragmenting materials	July 1971	July 1974	Australia	Army	[h]6 man-years	50.0
Basic research:						
Deep diving research	Oct. 1970	Continuing	United Kingdom	Navy	(i)	(i)
Shallow-water acoustic research	June 1972	Continuing	The Netherlands, Federal Republic of Germany	Navy	(h)	(h)
Aluminum alloy research	July 1968	Dec. 1975	Italy	Army	468,333	59.0
Improved photochromic materials	June 1971	Sept. 1974	Greece	Army	[h]3 man-years	50.0
Helicopter dynamics	Dec. 1971	Dec. 1974	France	Army	[e,h]12 man-years	50.0
Transient radiation effects on electronics as relating to leopard tank	Aug. 1971	Jan. 1975	Federal Republic of Germany	Army	(j)	(j)
Room temperature injection luminescence in wide band gap semiconductors	Dec. 1971	Mar. 1974	Canada	Air Force	70,000	50.0
Other:						
Thrust-measuring system (note k)	Fiscal year 1970	June 1974	Canada	Air Force	504,500	50.0
Azores fixed acoustics range (note l)	June 1968	Continuing	France, Italy, Canada, Federal Republic of Germany, United Kingdom, the Netherlands, Portugal	Navy	2,000,000	67.0

[a]The program agreement provides for follow-on coproduction.

[b]Contracts were awarded in November 1971. Italy, Germany, and the United States signed the Memorandum of Understanding on November 23, 1972.

[c]The United States is doing all the work and the Federal Republic of Germany is providing 50 percent of the funding.

[d]Estimated by responsible service official.

[e]Individual funding levels are classified; however, total U.S. share for both programs amounts to approximately $20.2 million.

[f]The United States-Canadian Defense Development Sharing Program, which is explained on page 17, does not include this program.

[g]Program work is being done by the United Kingdom; the United States is furnishing data and components.

[h]Work was divided equally between participants with each participating country funding its respective effort. U.S. costs could not be determined because the programs are tasks of larger programs. Likewise, budgets costs are buried within broader program elements appearing in military budgets.

[i]Indeterminable, since there is no separate budget line item for this project. Program documentation did not reveal the extent of U.S. funding.

[j]Project office officials stated the Federal Republic of Germany was providing total funding for the program and all work was being done in the United States.

[k]This program involves component improvement.

[l]Program does not involve development of hardware. The project consists of two phases: Constructing the range and conducting experiments using RDT&E funds.

PARTIAL LIST OF PAST INTERNATIONAL COOPERATIVE RESEARCH AND DEVELOPMENT PROGRAMS

TERMINATED BY SEPTEMBER 30, 1973

Program title	Foreign participants	Estimated U.S. investment	Outcome
Engineering development:			
Main battle tank (MBT-70)	Federal Republic of Germany	$523,700,000	Engineering development was terminated before completed due to severe development problems.
Mallard	United Kingdom, Australia, Canada	34,000,000	The program was terminated during development. The United States pulled out of the program because of interservice incompatibilities.
Miniature inertial navigation system	Federal Republic of Germany	4,783,000	Engineering development was completed in 1970. The system was not introduced into the U.S. Fleet because of reliability problems.
Air transportable maintenance shop (note a)	Canada	388,630	The program was completed. Two check test shops were procured and outfitted. The check test was completed in June 1971, and the shop was classified "standard A" on March 30, 1972.
XM-571 articulated utility carrier (note a)	Canada	14,065,705	The program was completed and the vehicle was classified "standard B" on July 27, 1971. The Army procured 46 vehicles but does not plan any additional procurements.
Advanced development:			
XJ-99 VTOL engine	United Kingdom	[b]30,000,000	Advanced development was completed in 1971; however, there was no application for the engine.
Rocket components for meteorological data-sounding system	Canada	552,713	The program was completed March 1973. Concepts were proven feasible.
Exploratory development:			
Ceramic armor materials (note a)	Canada	133,000	The program was completed. A new agreement for a development-sharing project on ceramic armor materials is not contemplated. Canada decided not to propose a new agreement because there was no net advantage for Canada.
Improved Shenitt-Gordon dispersion-strengthened nickel chromium alloys	Canada	30,000	The program was completed in April 1973, and the objectives were met.
Highfield superconducting magnets for magneto-hydrodynamic generators	Canada	(c)	The program was completed in April 1973, and the objectives were met.
Basic research:			
Fragmentation effects of mortar shells	Norway	50,000	The program was terminated in December 1971.
High acceleration effects on man	United Kingdom	(c)	The program was completed in August 1972 and the objectives were met.
Other:			
Type AN/ARA-59 direction finder (notes a and d)	Canada	[e]150,000	The program was completed in March 1971.
Rotary-wing aircraft cold-weather tests (note d)	Canada	(c)	There was testing in Canada, using U.S. supplied and operated OH-58A aircraft with Canadian forces support. The program was terminated in November 1971.
Snow testing of munitions (note f)	Norway	(c)	The United States provided materiel, data, and technical assistance. No exchange of funds was involved. Testing was completed during the winter of 1971-72.

[a]Entered into under the United States-Canadian defense development-sharing program.

[b]Estimated by program official.

[c]Documentation provided did not disclose the cost of equipment and services supplied by the United States.

[d]Product-component improvement funding.

[e]Actual investment.

[f]Management support funding.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D C 20301

21 AUG 1973

Mr. Harold H. Rubin
Deputy Director
(Technology Advancement)
U.S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Rubin:

The Department of Defense has reviewed your draft report on "Involvement in International Cooperative Research and Development - Benefits and Drawbacks" and is in essential agreement with its contents. Attached are specific recommended changes with appropriate comments and justification which will serve to clarify or amplify statements made in the report.[1]

There is no mention in the report of the many coordinating group activities and the technical centers associated with NATO. These activities do contribute to technical information exchange and the initiation of cooperative efforts and have led to specific bilateral and multilateral cooperative development projects. The NATO Conference of National Armament Directors (CNAD), its Defense Research and Armament Groups, the NATO Science Committee and the Advisory Group for Aerospace Research and Development (AGARD) are examples of these coordinating bodies which continuously provide a working mechanism for cooperation. The SHAPE Technical Center (STC) and the Senior Allied Commander, Atlantic (SACLANT) ASW Research Center are jointly funded and staffed research activities which support NATO military organizations in scientific and technical matters. Both of these activities contribute to the furtherance of international cooperative research and development and provide an excellent forum for considering specific cooperative development projects.

The Department of Defense is also engaged in bilateral technical information exchange with our Allies which has been formalized by government-to-government Data Exchange Agreements. These bilateral agreements have been concluded with many countries and cover a wide spectrum of technical military subjects. These information exchanges have led to joint development or production programs as well as to direct sales of U.S. military equipment.

[See GAO note 2.]

The Department of Defense concurs with the General Accounting Office recommendation that an annual summary report on U.S. International Cooperative Research and Development Activities be prepared for submittal to the Congress.

for Malcolm R. Currie

Attachment
as

GAO notes:

[1]The report has been revised where appropriate to reflect changes suggested in the attachment.

[2]The deleted comments related to report classification and no longer pertain to this report.

PRINCIPAL OFFICIALS
RESPONSIBLE FOR THE ACTIVITIES
DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
:RETARY OF DEFENSE:		
James R. Schlesinger	July 1973	Present
William P. Clements, Jr. (acting)	May 1973	July 1973
Elliot L. Richardson	Jan. 1973	May 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
Clark M. Clifford	Mar. 1968	Jan. 1969
Robert S. McNamara	Jan. 1961	Feb. 1968
'UTY SECRETARY OF DEFENSE:		
William P. Clements, Jr.	Jan. 1973	Present
Kenneth Rush	Feb. 1972	Jan. 1973
Vacant	Dec. 1971	Feb. 1972
David M. Packard	Jan. 1969	Dec. 1971
Paul H. Nitze	July 1967	Jan. 1969
Cyrus L. Vance	Jan. 1964	June 1967
.ECTOR OF DEFENSE RESEARCH AND :NGINEERING:		
Dr. Malcolm R. Currie	June 1973	Present
Dr. John S. Foster, Jr.	Oct. 1965	June 1973
Dr. Harold Brown	May 1961	Sept. 1965
DEPARTMENT OF THE NAVY		
RETARY OF THE NAVY:		
John W. Warner	May 1972	Present
John H. Chaffee	Jan. 1972	May 1972
Paul R. Ignatius	Sept. 1969	Jan. 1969
Charles F. Baird (acting)	Aug. 1967	Sept. 1967

	Tenure of office	
	From	To
DEPARTMENT OF THE NAVY (continued)		
Robert H. B. Baldwin (acting)	July 1967	Aug. 1967
Paul H. Nitze	Nov. 1963	June 1967
CHIEF OF NAVAL OPERATIONS:		
Adm. Elmo R. Zumwalt, Jr.	July 1970	Present
Adm. Thomas H. Moorer	Aug. 1967	June 1970
Adm. David L. McDonald	Aug. 1963	July 1967
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY :		
Howard H. Callaway	May 1973	Present
Robert F. Froehlke	July 1971	May 1973
Stanley R. Resor	July 1965	July 1971
ARMY MATERIEL COMMAND:		
Gen. Henry A. Miley, Jr.	Nov. 1970	Present
Gen. Ferdinand Chesarek	Mar. 1969	Nov. 1970
Gen. Frank Besson	Aug. 1962	Mar. 1969
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE:		
John L. McLucas	July 1973	Present
John L. McLucas (acting)	May 1973	July 1973
Robert C. Seamans, Jr.	Feb. 1969	May 1973
Harold Brown	Oct. 1965	Feb. 1969
AIR FORCE SYSTEMS COMMAND:		
Gen. Samuel Phillips	Aug. 1973	Present
Gen. George S. Brown	Sept. 1970	Aug. 1973
Gen. James Ferguson	Sept. 1966	Aug. 1970
Gen. Bernard Schrieber	April 1959	Aug. 1966

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