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# NATO Cooperative Research and Development: A Case for Expansion

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DEPARTMENT OF STATE A/CID/AMR

REVIEWED by W. Bruce DATE 7/29/91

EXEMPTED ( ) , DECLASSIFY

EXEMPTED ( ) DECLASSIFY in PART

EXEMPT ( ) Non-responsive info.

FGL, RO or PA exemption: \_\_\_\_\_

Authority to:

( ) CLASSIFY as \_\_\_\_\_, OADR

( ) DOWNGRADE IS to ( ) S or ( ) C, OADR

Twenty-Ninth Session

1986 - 1987

## The Senior Seminar



United States Department of State  
*Foreign Service Institute*

*This study has been prepared as part of the curriculum of the Senior Seminar. The views expressed in the study are those of the author; they do not necessarily represent either those of the Foreign Service Institute or of the Department of State.*

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## INTRODUCTION

This short paper is not written by an expert in defense related matters. The selection of this topic came about in an evolutionary manner, i.e. in a process of several phases of conversation with various experts in the field, the specific topic emerged as each official kept talking about what was currently important. The concept of improving NATO's posture of readiness in the future by urging more cooperation in the research and development of conventional weapons systems seems so logical as to be expected, normal and something which is old hat. It became clear that in NATO's 36 year history this concept had been tried before yet never succeeded. Programs of a cooperative nature certainly have, but not ones that were started from the very beginning, i.e. not ones which began with transatlantic research and development from the inception of the idea for the weapon or system. Cooperation was marked by a lack thereof, not a trend toward innovative improvement. Senator Nunn's initiative is aimed in the right direction from this author's perspective, and the Department of Defense has eagerly worked to make it a success. International cooperation involves international differences of opinion and respective focus of interests--national interests. This paper touches on these points; it is up to the actors to make the differences into agreements and the initiatives work.

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RESEARCH

The research attendant to putting this short article together was a combination of interviews in the U.S. and travel to Ireland and the United Kingdom. The following officers and officials deserve a special note of "Thanks" in that they took the time from their busy days to instruct and inform the author. They were dealing with a "tabula rasa" in effect and thus the task was more difficult than may be expected. Special thanks goes to the following DOD personnel: Colonel Frank Watkins USAF, Colonel Ronald Obermeyer USAF, Lt. Colonel William McClelland USAF and Colonel Kevin O'Connor USAF. From the British Embassy in Washington: Air Commodore Leslie Swart RAF and Dr. George Rose, Technical Staff Officer to the Deputy Head of the British Defense Staff. The Washington offices of Ferranti plc.: Mr. Peter Gibson and Mr. Ronald Priestly and at Ferranti Defense Systems in Edinburgh, Scotland: Mr. Phillip Atterton, Managing Director and his officers, Mr. E. Henney, Mr. J. Watson and Mr. Hamish Duncan. Thanks too to Sir Peter Bairsto their military consultant. Mr. John Arnall, the Head of Research and Development for British Aerospace, kindly made time from his busy schedule to provide an overview and general comments. At the Irish Embassy in Washington, the Economic Counsellor, Mr. Antoin MacUnfraidh, was particularly helpful as was Mr. Paul Sheane of the Shannon Development Authority in Shannon. Mr. Algirdas Rimas, First Secretary of the U.S. Embassy in Dublin, as well as Mr. Thomas Lyons of the Irish Department of Foreign Affairs made important contributions to understanding the position of a non-NATO nation and the potential role it could play in cooperative R&D.

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CHAPTER I

THE NUNN INITIATIVES AND STRUCTURAL  
DISARMAMENT OF NATO

The countries of the North Atlantic Treaty Organization (NATO) are being offered a new initiative, one so important as to go to the heart of the matter that created the Treaty Organization itself. It is an initiative designed to spawn collaboration in the future, to once again attempt to have a strategy formulated to pool resources to make the Organization function in a unified manner. This initiative is to offer the opportunity for collaborative research and development (R&D) of conventional weapons systems at a time when the trend within the Organization is often toward polarization of effort.

Collaboration within the NATO Alliance has never been taken seriously. Individual countries went their own way when it came to important weapons systems, especially those systems that were expensive and/or offered the prospect of sale throughout the Organization and in some cases, to countries of the Third World which had reasonable prospects to offer as good customers. If cooperation was successful it was with minor systems development undertaken in the name of cooperation (with a capital "C"), i.e. for its own sake or to further the semblance of unity and agreement within NATO at a time of stress or challenge from the Warsaw Pact.

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Defense appropriations are growing larger and it has been recognized that the Alliance is getting "less bang for its buck". This realization along with ever increasing challenges in the future coupled with a dismal history of lack of cooperation in systems development has lead to a new initiative from the United States which may begin the process of bringing the countries of the Organization back together to produce more efficient and cost effective conventional weapons to defend the free world. This initiative, dubbed the "Nunn Amendment" (see appendix A) has been the result of the work of many. One of the more prophetic voices of the past however, belongs to that of a retired U.S. Naval officer, Thomas J. Callaghan. Callaghan has been active in his desire to enhance the fighting capability of NATO matched with his concern about what he calls the "Structural Disarmament" of this Organization. While some funding and much talk had been given to improve a steadily worsening situation within NATO regarding cooperation in weapons development, Callaghan's writings did not find force of legislation designed to offer new opportunities to force cooperation. In 1985 and finally 1986, the Democratic Senator from Georgia, Sam Nunn, put together an amendment to the FY 1986 Defense Authorization Bill before the 99th Congress to allocate funding to encourage government and private industry to find cooperative areas of R&D among the countries of the Alliance to improve the capabilities of NATO. The Pentagon refers to terms such as "Interoperability and Standardization" but none of this is attainable without first initiating the process of cooperation now for the future.

The "Nunn Amendment" called for the appropriation of \$200 million to be divided equally amongst the Army, Navy, Air Force and Defense Agencies..only for...NATO cooperative research and

development projects. Seed monies were also provided (\$50 million) for what was termed "Side-by-Side Testing". This, to allow for the acquisition of items of manufacture by the non-U.S. member nations of NATO by enabling testing of these systems in comparison with similar systems developed by U.S. contractors. Although Congress appropriated \$100 million in FY 1986 for cooperative R&D and only \$25 million for Side-by-Side Testing, approximately \$161 million and \$40 million were additionally appropriated in FY 1987 to continue the Nunn initiative. The funds must be spent only in the U.S. These are significant sums if treated as "seed-monies", not as ends in themselves nor as the sum totals of a completed package or process. Provisions of the Amendment specify that, (1) one or more NATO partners must offer an "equitable share" vis the U.S. contribution, (2) a Memorandum of Understanding must be agreed to and signed defining the scope of the particular effort and (3) approval must be obtained from the Secretary of Defense or his deputy or appropriate authority. The point here is that this could be the beginning of a new era within NATO if the participants are willing to apply themselves and take some reasonable risks in the area of technological exchange. In short, the aims of this initiative are to:

Share technology--reciprocally--to avoid unnecessary duplication of developments;

Support interoperability;

Urge greater investment by allies in conventional military equipment;

Achieve economies of scale by coordinated research, development, production and logistic support programs.

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Senator Nunn's preamble to his "Amendment" clearly stated the concerns within the Defense Establishment of the U.S. as well as his own and that of his Congressional colleagues when he stated: "...for more than a decade the member nations of the North Atlantic Treaty Organization have provided in the aggregate significantly larger resources for defense purposes than have the member nations of the Warsaw Treaty Organization; that, despite this fact, the Warsaw Treaty Organization member nations have produced and deployed many more major combat items such as tanks, armored personnel carriers, artillery pieces and rocket launchers, armed helicopters and tactical combat aircraft than the member nations of NATO; and that a major reason for this discouraging performance by NATO is inadequate cooperation among NATO nations in research, development and production of military end-items of equipment and munitions..."<sup>1</sup>

Senator Nunn's goal is to improve NATO's capabilities and get the most "bang for our buck". It is an effort which could have the effect of arresting Mr. Callaghan's "Structural Disarmament" that NATO has experienced because so many duplicative weapons systems have been developed as national programs, produced in small quantities at high unit cost for one of a few member countries, and require unique logistical support.

Following World War II there were within NATO a series of programs and initiatives designed to spawn informational exchanges. There was the NATO Conference of National Armament Directors and the Tri-Partite Technical Cooperation Program along with a series of umbrella-type international agreements of a bilateral nature which the U.S. specifically formulated to

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spur cooperative R&D...U.S. military assistance programs, grants and foreign military sales efforts rebuilt the technological capability within NATO after the war in those countries of the Continent which had seen devastation. Britain initially continued to forge ahead in new fields of weapons design and aircraft manufacture borne of a strong technological base created during the war years. Challenges to U.S. preeminence in the field of weapons design and development surfaced both within the Alliance as well as from those nations outside the Treaty who placed a high degree of emphasis on education in the scientific and technological disciplines. The specifics of the Treaty itself, binding the North Atlantic signatories, made no provision for the exchange of research nor development of new technologies in a collaborative way. Despite the creation of those commissions and bilateral agreements mentioned above, there was no real atmosphere created for the efficient trade of weapons, ideas nor technologies amongst the partnership. In a prophetic article written in 1974, Thomas Callaghan called for renewed efforts to stimulate military and civilian technological cooperation.<sup>2</sup> Writing a decade later in NATO Review he recalled his landmark piece, pointing up the fact that little had been done in the intervening ten years to change the picture of collaboration and noting that a process of "Structural Disarmament" had begun within NATO that had to be arrested. His prediction regarding this process was foretold in testimony in 1977 given before the Legislation and National Security Committee of the Government Operations Committee of the House of Representatives, when he said:

"I think if present trends continue, without a North Atlantic defence market structure, the United States, providing 20 per cent of NATO's forces, will be spending more and more money developing a full range of military

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systems, inadequately funded, as the Senate Armed Services Committee recently pointed out- and produced in ever smaller numbers, in a vain attempt to achieve qualitative superiority over the massive conventional forces of the Warsaw Pact.

"Europe, providing 80 per cent of NATO's collection of forces, will fail to organize its defence procurement effort on a united and collective basis, so the time will not be too distant when the 12 armed nations of Europe will lack the resources, either to develop and produce economically themselves - or to procure from the United States - weapons which can compete in quantity and quality with those of the Warsaw Pact.

"This is a formula for the unilateral disarmament of NATO, sometime in the next 5 or 10 years, bringing us face to face with the danger President Kennedy warned against: surrender, or nuclear war."<sup>3</sup>

Mr. Callaghan defines "Structural Disarmament" as occurring when a nation's defense budget, plus arms exports, provide too small a market to bring armament development and production costs down to a politically affordable level. This can happen even when a government is spending more money to rearm (reference the comments of the Nunn Amendment preamble). Mr. Callaghan maintains that this process of disarmament will continue and indeed may even accelerate until "...NATO governments establish an intercontinental market structure for the production and exchange of armaments." Author Callaghan cites the example of Britain after the war as declining from a position of dominance in the field of aircraft manufacture to that of a nation that can no longer produce a single combat aircraft by itself. High weapons cost forced British manufacturers to stretch out development and production. This results in lower annual costs, but much higher total and specific unique costs. The cost was stultifying. As work continued on the cutting edge of technology and costs rose, even stretched projects had to be

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cancelled. Two ballistic missile projects and six different interceptor aircraft and five transport aircraft along with aero-engine designs had to be scrapped. The causes for this were cited in a 1979 parliamentary report by former MP, Alan Williams:

"The tragedy of Britain's post-war defence policy is that Britain came out of World War II with a near superpower defence industrial base. Only a continental-scale defence market could have sustained that base. Two options were available: co-operation with the United States, or co-operation with Europe. The tragedy is that Britain, regardless of party, did neither.

"It was not until after the 1964 Plowden Report on the British aircraft industry that Britain officially recognised that if it were to sustain healthy defence industries, it needed a defence market far larger than its own national market. Following the Plowden Report, Britain did pursue co-operation, but on a project-by-project basis, rather than on a continental scale. Thus, economies of scale were lost pursuing (co-operation) within a single project."<sup>4</sup>

Mr. Callaghan maintains that the process of this "Structural Disarmament" was a long time in the making. He states that the consequences of too many projects and too little money can be only fended off for so long. By the time 1980 rolled around, the effects of insufficient money and low production levels for weapons systems had concepts of combat readiness and "sustainability" called into question. This was apparent to all and the advent of the Reagan Administration witnessed a vigorous effort to reverse trends. Procurement levels were increased by 63% in 3 years yet Congress noted the decline and the trend of producing less with more money. Committee reports indicated among other examples in 1984 (with only minor changes taking place between 1984 and 1986):

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"Eight of the 13 production lines building Navy aircraft are turning out fewer than 20 planes a year; three of these lines will produce only six aircraft, causing 'exorbitant unit costs and wasted resources'.(1982)

"Last year there were 13 production lines: this year 16, and next year there will be 20. This increase in Navy production lines results in higher unit costs, and slower deliveries of new aircraft to the fleet.(1983)

"The proposed reduction of 135 M-1 tanks to be procured this year will stretch-out procurement an additional two years and add about \$473 million to the total programme cost.(1983)

"The most economically efficient production rate for the TOW II missile is 1,800 per month. The Army's five-year plans make no provision for ever reaching the 1,800 per month production rate.(1983)"<sup>5</sup>

The need to get at the heart of the problem drove planners to the requirement for more collaborative efforts, more pooling of resources. Callaghan, writing in 1984, believes that a new European Defense Industrial Community should be established with the following goals for all European members of the Alliance to attempt to achieve:

"This Community must first be capable of producing weapons and equipment efficiently, and to an intercontinental scale. Second, there must be a division of labour between Europe and North America. Third, subcontractors in Europe and North America must be able (indeed encouraged) to bid to prime contractors on either side of the Atlantic (subsequent to this writing, approval has been granted to allow for reciprocal procurement Memoranda of Understanding to allow for trans-Atlantic bidding by European prime contractors for U.S. proposals.). Fourth, there must be agreement that all unnecessary duplication of defense industrial effort will be eliminated. Fifth, there must be agreement that the financial burdens and economic benefits (jobs and technological pride and progress) of NATO's defence, will be shared equitably and efficiently. Sixth, there must be a reasonable period for the European governments to make

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the full transition from 15 national markets to one continental market. Seventh, interim intercontinental projects must be undertaken during the transition period.

"As in the commercial world, free trade must always be the goal. But there must also be the recognition that, just as in that real commercial world, compromise must determine the politically attainable goal. The political balance will probably be struck between the equitable solutions the Europeans will want in return for sharing NATO's financial burdens, and the efficient solutions the Americans will want in return for sharing the economic benefits."6

Whether or not his kind of Industrial Community can be achieved is unclear. Mr. Callaghan's points regarding the future are clear and prescient. He is correct in pointing out that no one country within the Alliance can provide a large enough domestic market to develop and produce weapons at a politically affordable cost; that no one country can develop and produce every weapon all by itself--there must be a division of labor: unnecessary duplication e.g. competitive prototypes, multiple approaches and backups etc. makes matters better. Structural rearmament with conventional weaponry precludes total reliance upon nuclear response. The Nunn initiatives seek to give force to this argumentation and support to sustain its goals.

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CHAPTER II

THE VIEW FROM THE PENTAGON

The response to the Nunn Amendment Initiatives from the Department of Defense (DOD) has been impressive and sincere. The intent of the initiatives is viewed as positive and the problem they address real. Mr. Callaghan's definition of the problem and the need for expanded programs of cooperative R&D, supported by the Nunn initiatives, has the full backing of the Office of the Secretary of Defense, and the result has been the announcement of a new five-year effort on the part of DOD to amount to a total commitment of budgetary funding of \$2.9 billion through 1992. Deputy Defense Secretary William Howard Taft IV reported the results of a seven-nation visit made in November 1986 specifically related to the discussion of cooperative R&D. Noting that U.S. monies are to be spent in the U.S. (the exception being that provision of the Amendment for acquisition of items from Europe selected for Side-by-Side Testing), the Deputy Secretary indicated his encouragement that the allies, on their part, will look for comparable funding to begin work on new cooperative programs.

It is the intention of the Pentagon to begin work in support of the Nunn Amendment if only two or three countries agree to collaborate rather than seek a minimum level of cooperation for all of the countries of the Alliance or those

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within the Organization who may be interested in a particular project. Taft's position was supported by that of his Special Advisor on Armaments Cooperation, Mr. Dennis Kloske, who stated in December 1986 that by not waiting for all interested or potentially interested countries to sign up for a particular program or project: "We intend to avoid milestones that stretch for infinity."<sup>7</sup> NATO's International Staff had previously reported that the slowest country to come to the decision point held all of the rest back, thus creating a slow pace that resulted in few initiatives being launched.<sup>8</sup>

The DOD concern is that this slow pace will not indicate positive results fast enough to please the Congress and thus discourage continued funding of the Nunn initiatives. Results count. Pressure is building in the Congress to demonstrate concrete progress on the cooperative initiatives. DOD has not limited the quest for cooperative R&D work to the confines of the NATO establishment. They have recognized the work being accomplished in pro-Western non-NATO countries that have mutual defense treaties with the U.S., such as Israel, Australia, Japan, Egypt and Korea. Other countries could be added to this list, such as Ireland which will be discussed later in this paper.

A complete and detailed listing of current U.S. funding for Nunn Amendment Projects can be seen in Appendix B. What is important to note at this time is that this funding is taking place to encourage international initiatives in the face of a \$170 billion trade deficit. There will be a trade bill proposed in the 100th Congress. While it appears that this will have something of a "protectionist tone" to it, Nunn initiatives will most likely be spared in an effort to see if

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this new program can bring about the needed change in NATO. An example of this willingness to keep the experiment alive can be seen in the defeat of a protectionist amendment offered by Senator John Glenn (D-OH) which was accepted by the Senate in August 1986, to bar foreign participation in the Strategic Defense Initiative (SDI) program. Senator Glenn's amendment would have barred foreign SDI participation if the work could have been "...reasonably performed by a U.S. firm." Glenn cited the trade deficit in 1986 and added that SDI "...should be research by and for America."<sup>8</sup> The House version of the FY 1987 Defense Appropriation Bill contained no restriction on foreign participation in SDI. In conference the Senate dropped the proposed amendment, pressure coming in this instance from within the Chamber as well as from the Department of State and DOD.

No discussion of the efforts on the part of DOD to make progress on Nunn initiatives can be conducted without the issue of the "Two-Way Street" arising. The term, "Two-Way Street" refers to the European concern about trade imbalance with the U.S. in the armaments area. The facet of the Nunn Amendment that most clearly applies here is that of the provision for "Side by Side Testing". According to Deputy Secretary Taft, this provision will continue to reduce the imbalance which was about 7-1 in the U.S. favor in 1980, beyond that of 3-1 in 1986 to a position that localizes the problem within the Alliance. Things have improved with France which, had they not recently decided to buy AWACS from the U.S., would have seen an imbalance in their favor before the end of 1987 and a position of near parity with the United Kingdom with the exception of the recent decision by the U.K. regarding their purchase of AWACS. (However, recent indications are that Boeing and the

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Government of the U.K. have agreed to offset costs and have agreed to reach parity spending levels of purchase costs with reinvestment requirements with regard to airframe, power plant and avionics of the AWACS package.) The position taken by the Office of the Deputy Secretary is that the future of the issue of the Two-Way Street is one based on industrial competitiveness and on meeting genuine military requirements. It is clear that some countries, if they are to be competitive, will have to invest more in R&D than in the past. Interviews conducted for this paper indicate a capability exists in some instances and where it does not, there is willingness to compete and invest the sort of monies necessary to ensure a fair chance at obtaining market share. (More on this will be included in the following chapter.) Suffice it to say, there are twelve programs thus far agreed to under the Nunn initiatives by the 14 NATO partners. It is a start which needs expansion.

This start needs more funding. The amounts allocated will have to be increased and the will to make the programs work will have to continue to be encouraged. It seems apparent that what the Nunn Amendment can start, U.S. industry will have to see through the final stages of development. Funding will have to be at appropriate levels in the R&D phases to balance the risk of competition and the potential of winning contract approval to move to the production phase. Focus caused by the Nunn initiatives is new in concept in that for the first time, projects are to be attempted from the very beginning. Beginning from the conceptual stages, i.e. the idea and then its initial design, has not been tried within the NATO community before. Collaborative programs in the past were undertaken only after the initial R&D phases were completed.

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Changes borne of collaboration came as particular mission requirements were defined, i.e. changes were not significant to the basic structure nor design of the weapons system.

Ambassador David M. Abshire, while still in his previous posting as the U.S. Ambassador to NATO and in response to a question regarding funding for the Nunn initiatives, stated that he believed more funding would be forthcoming from the Congress. Of the funds already appropriate, he said: "That money in effect is seed money or venture capital--start up money for programs....I am greatly encouraged by Will Taft's decision to program money to support Service participation in all Nunn cooperative programs through 1992. The combination of initial seed money plus the POM follow-on is approximately \$2.9 billion. That takes your breath away. But it is essential that our NATO allies make proportionate commitments."<sup>9</sup>

Ambassador Abshire went on to stress the fact that our European allies would have to bring their own money to the table (a provision of the Nunn Amendment). If a European company is interested in participating in this program under the Nunn initiatives it would have to do so through its own Defense Ministry. "The U.S. money does not come directly. The new development for contractors is that they will have a stable transatlantic framework."<sup>10</sup> Abshire is also optimistic about the intent of the Department of State in working with DOD to further these efforts and noted in December 1986 the fact that Dennis Kloss recently authored a lengthy message sent to all U.S. embassies and commands in Europe outlining this program and giving detailed information on the ground rules.

The issue of proportionate share with regard to the overall cost of NATO arises, usually in conjunction with complaints

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within the U.S. that the U.S. is paying a disproportionate share of the total cost. However the figures are calculated, the results are the same, i.e. reflective of growing criticism of the effectiveness of NATO and the U.S. role therein. Vigorous European participation in these initiatives for enhanced R&D may serve to attenuate some of this criticism.

DOD and State Department personnel stationed abroad and responsible for making cooperative R&D programs work are quick to point out that there is no European equivalent of the Nunn Amendment. The ability of European governments to make monies available and/or switch their emphasis in funding within their budgets is suspect at best. Time is a key factor and enters into much of what is to be done. Expectations from the U.S. Congress continue to run high. It should not be overlooked that the 1986 Nunn Initiatives came as a surprise to our European partners. Their planning and programming as well as budgeting processes are less flexible than that of the United States with the result that it is taking them longer to make monies available for the opportunities provided under the Initiative. This necessitates in some instances that the U.S. fund the initial portion of a collaborative program, permitting the European partner the time necessary to allocate funding for the final phases of R&D.

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CHAPTER III

THE EUROPEAN PERSPECTIVE

A. FROM WITHIN THE ALLIANCE:

The U.S. initiatives designed to expand cooperative R&D are viewed in Europe with a healthy degree of skepticism. old wine in new bottles some might say; while others have the view that this is a notion whose time has come. In any case, European participants want to be involved and want more of a market share of new programs. This quest for more of a share of the potential NATO arms market raises the issues of a) the "Two-Way Street" and b) European opinions of an overemphasis by the U.S. on "Technology Transfer". In both instances, U.S. officials continue to insist that there are significant improvements being made. European manufacturers believe that in some cases one issue serves the needs of the other. More specifically, U.S. concern over "Tech Transfer" blocks European firms from bidding, thus contributing to a continuation of the imbalance in weapons sales in favor of the U.S.

If there are two core or vital points made by European firms they are that the U.S. official bureaucracy is too clumsy and prone to buy "American" and sell "European" and that the various "munitions control" authorities within the United States Government are too slow to release holds on old

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technology and too prone to conservative and unrealistic views with regard to the transfer of technology. These two complaints are frequently raised without rancor, rather in tones designed to be constructively critical.

Recognizing the need for unilateral expansion of military R&D funding if they are indeed going to participate more fully in this initiative, many within the Alliance are moving quickly to remedy the situation. The U.S. spends roughly four times as much on military R&D as all of Western Europe combined, i.e. approximately \$40 billion as compared with about \$10 billion. Many governments within NATO are concerned that their technical competence is being threatened in this regard. Military R&D is difficult to separate from general scientific research. European problems with "brain drain" may well find some remedy in increased funding for R&D within their respective defense budgets. France has approved a 19% increase in its military R&D allocation for 1987 with an overall growth in its defense appropriations of 7% over last year. West Germany only allocates 5% of its defense expenditures toward military R&D. Britain is in better shape with approximately 10% of its overall defense spending slated for R&D. More needs to be done.

Deputy Secretary Taft, upon returning from his November 1986 trip to NATO's southern tier commented positively on what he saw as a concerted effort to improve R&D capabilities:

"Their facilities are competitive with anything that exists. But anybody can build a new plant. What was impressive was the attitude of their management and the quite eminent capability of their work forces: They have trained these people to contribute, and they are looking to get involved in R&D projects, not just build something

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someone else designed. They have R&D capabilities. I was not surprised, but I was certainly pleased that they are ready and that they have the support of their defense ministries."11

Deputy Secretary Taft emphasized that U.S. funds for security assistance programs are being reduced. This places new importance upon increased investment in R&D on the part of the Alliance. European aerospace industries must become more self-reliant and more competitive in modern armaments. Taft noted positively the fact that the Independent European Program Group had asked countries there to study how less well-developed technological industries could best contribute to the cooperative R&D initiatives.

For those defense industrial firms who are fully developed, market share is the concern. Cooperative programs of the past within NATO such as the F-104 Starfighter, AV-8A and AV-8B Harriers, the Sidewinder and Sea Sparrow missiles, the F-4 Phantom, the C-130 in its various models and the NATO airborne warning and control system, have all to varying degrees been successful. This list is by no means complete. It is reflective of mutual effort attendant to designs already developed by one or another partner within the Alliance. This kind of cooperation will continue to expand under the provisions of the "Side by Side Testing" portion of the Nunn plan and as mentioned earlier, serve to reduce the force of the European argument with regard to the "Two-Way Street". (See Appendix C). There are many examples of this, most notably the \$904 million approved by Congress in FY 1987 for the U.S. Army's Mobile Subscriber Equipment. GTE and its French partner, Thomson-CSF, won this multi-billion dollar contract in the fall of 1986. Also appropriated was \$10.1 million

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requested to buy 157 of Royal Ordnance's improved 81mm mortars and \$26.5 million for 64 of the British firm's 105mm light howitzers.

In the wake of the DIVAD gun program failure (featured in Senator Nunn's planning for his Amendment's focus and thrust), Congress approved \$20.6 million for the Army to "...acquire, test and evaluate solely air defense systems which are currently in operational use." Prospective European candidates for this competition include British Aerospace's Rapier, Sweden's Bofors' RBS-70, the Martin Marietta-Oerlikon ADATS and Euromissile's Roland. Other Congressional action involving "Two-Way Street" issues were:

- Army R&D funding for the terminally guided warhead for the MLRS, coproduced by the UK, France, Germany, and Italy, was approved at \$42.6-million for FY87.
- \$182-million was provided for the Navy's T-45 training system, derived from the British Aerospace Hawk aircraft.
- Testing funds for Euromissile's Milan II antitank weapon was set at \$10-million.
- \$62.7-million was provided to continue buying Durandal runway-cratering munitions produced by France's Matra.
- \$69.5-million was provided to buy Sweden's Bofors' AT-4 Light Multipurpose Weapon for the US Army.
- Congress fully funded the \$18-million requested by the Pentagon for its Foreign Weapons Evaluation Program, over and above \$40-million for side-by-side testing under the Nunn Amendment.<sup>12</sup>

The issue of "Tech Transfer" remains real. It is also a polarizing one in that it presumes that the U.S. has continued preeminence in the field of "hi-tech". In some cases this is clearly a myth. Policymakers continue to seek new areas of

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accomodation and middle ground. The best course is to treat each instance separately and with as much care as possible. What is clear is that new frontiers of technology can and are being pushed rapidly--daily in some instances. The effort to securely control genuine "break-through" technology is respected and understood on both sides of the Atlantic, but what is also clear is that in some instances, the "break-through" can take place in Europe. Short of this, it is very difficult to maintain controls on defense-related technology, i.e. the commercially available equipment which can have defense application if modified. Cited often is the famed Apple II computer example. Any notion that the U.S. sets the world standard for all technological innovation and that America has little to gain from other nations is simply not so. NATO risks losing its competitive edge in developing and applying new scientific innovations if, within the Alliance, cards are played too closely to the vest. It is the famed "judgement call" as to when and where and with whom we share our more closely protected secrets. Yet share, to some degree, we must if we are to gain in the long run.

European manufacturers can and do lead in some specific areas of defense related technologies. The Harrier from British Aerospace is clearly an aircraft that sets the standard in this field of "jump jet" technology. More subtle are those areas of avionics and aerospace electronics where particular firms hold unique capabilities

When considering unique cases involving the exchange of highly specialized technological information, distinctions can and must be made among allies. Some relaxation of control can and should be made to further advance a particular line of

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development when it is clear that a firm may hold proprietary rights to capabilities that can advance a design or technique employed. Britain, among other prominent members of the Alliance, holds a commanding edge in various disciplines. The U.S. has in the past worked out special bilateral arrangements with the U.K. and can do so with other nations within the partnership. There are, for example, 110 collaborative agreements between the U.S. and the U.K. currently in force. Probably the best known of these agreements deals with nuclear missiles, signed in 1958. The U.S. and Royal Navy have collaborated uniquely over the years to deploy nuclear submarines to the benefit of both nations in seeking to maintain a credible deterrence.

It is the opinion of experts on the European side of this transfer equation that the more specific the program on which the exchange is based the more secure its secrets will be. Conversely, the larger the program, the more countries involved, the more contractors incorporated into the project, the more likely the possibility of leakage.

U.S. export control mechanisms must, in the view of the European manufacturers and in some cases, governments, receive new attention with an eye toward relaxation. Despite official denials and some rethinking, the European Fighter Aircraft (EFA) program was launched, developed and produced in a "Europe Exclusive" manner in order to ensure maximum sales after production without regard to restrictions anticipated if American technology was incorporated into the craft. The Eurofighter Board, comprised of the participating nations (Britain, West Germany, Italy and Spain), has set bidding regulations (pertaining to companies who wish to be considered

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for inclusion into the final product, most principally in the various avionics configurations) such that they will exclude U.S. firms from bidding on EFA sub-contracts which could be worth billions of dollars. "The new Eurofighter rules state that the four-nation consortium will not accept bids from companies that cannot guarantee complete freedom to export all components or list the countries to which the components cannot be exported."<sup>9</sup> It is commonly known that the U.S. Government refuses to state in advance which countries are on its export denied area list. While this is understandable, it is clear that the EFA regulation aims specifically at this fact. Clear too, is the fact that the EFA consortium would like to maintain the option of selling the fighter to Eastern European nations as well as "non-aligned countries" which would be obviously "black-listed" by the U.S.. U.S. aerospace officials are not pleased at this turn of events and oppose their government's restriction on exporting their components to third countries if the items are available elsewhere. Faced with a choice of picking a U.S. firm or a European contractor who can provide similar if not the same kind of component without export control limitations, the EFA Board will undoubtedly choose the European firm. Apart from initial sale, there is spare part and product support services after sale to consider. Time and further negotiations as well as some specific requirement satisfied only by the U.S. unique equipment, may settle this apparently nettlesome problem. It is, however, symptomatic of European feeling with regard to U.S. overconcern and in some cases preoccupation with the concept of "Tech Transfer".

Collaborative R&D will require the exchange of vital information. Programs which have not yet left the drawing

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board or which remain in the theoretical stage must rely heavily on the full and free exchange of ideas. If collaboration in areas of research and development are to succeed as Congress wishes them to, then some new standard of bilateral arrangement must be arrived at to ensure the vital transfer of technology. Current programs of exchange already receive annual review. Possibly within this framework of annual monitoring, the new programs yet to be devised can see light of day. While the U.S. holds the current "state of the art" when it comes to "stealth technology" it will only be a short matter of time before key European firms begin to develop their own capability in this field. A strong argument is made by European manufacturers for more of this kind of exchange at this juncture and under the aegis of the Nunn initiatives.

Ambassador Abshire, commenting on this critical European agenda item, stated: "I think that in the trans-Atlantic relationship it is very important that technological transfer and technological protection work hand in hand, and not on an adversary basis. I think that we need to make great efforts through improved security, through industrial security, and all technology protection."<sup>13</sup>

## B. FROM OUTSIDE THE ALLIANCE:

There is keen interest on the part of countries that are not part of the NATO Alliance in obtaining a share of U.S. defense business. There are as well countries who are interested in benefiting indirectly from an increase in U.S. cooperative R&D activity even though their politics may preclude direct involvement in U.S. defense contracts. Israel, Australia, Japan and the Republic of Korea were specifically

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identified by Senate and House conferees as countries outside the NATO Alliance which could receive DOD monies for cooperative R&D. This amendment was to section 27 of the Arms Export Control Act set to apply for FY 1987. The House also wished to allow the Secretary of Defense the maximum latitude in the definition of the countries designated as non-NATO allies with the concurrence of the Secretary of State. (The Secretary of Defense and Secretary of State both agreed to add Egypt to this list.)

This amendment opens the field for more cooperative R&D and was intended to provide extra impetus to Nunn initiatives. Some say it was intended to appease our non-NATO allies which felt "left out" of the Nunn Initiatives. The Senate bill in this regard contained a provision (section 1209) that would allot up to \$40 million for Cooperative R&D Projects with major non-NATO allies, defining the term "non-NATO ally" as a country which shares with the U.S. a mutual commitment to freedom and individual freedoms. Broad language to say the least. (As of this writing no funding has been appropriated.)

In this latter regard, a country such as the Republic of Ireland would qualify if their political proscriptions supporting their professed policy of neutrality would allow them to participate. Switzerland and Sweden would also fall into this category of nations. All of these countries have sound bases from which to launch cooperative R&D projects. Ireland in particular draws on a wide variety of U.S. affiliates established in that country under favorable financial and political supports. Not unlike research parks in the U.S., Ireland offers industrial zones such as that located at

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# Shannon

Shannon, which have direct support from technical institutes (in this case the National Institute for Higher Education) which can and do provide laboratory assistance to manufacturing firms within the industrial zone as well as manpower in the form of highly qualified graduates ready to go to work for the companies located there (See Appendix D).

Ireland's politics are stable. Close adherence to the principle of "neutrality" may preclude involvement of U.S. or foreign based affiliates from undertaking classified research, and it would be difficult to ascertain with any degree of certainty that a particular project undertaken might not have a dual function or purpose. U.S. DOD contracts of an unclassified nature are already being fulfilled at Shannon with work satisfying U.S. military specifications. Companies that make computers for video games can also make computers for flight controls of F-16 or F-18 aircraft. Radar systems designed for commercial or civilian application cannot be divorced from a military role. So-called "Hi-Tech" pockets have surfaced in various locales in Europe, Shannon being only one of them. There is no reason why policy planners cannot extend the terms and definitions of "non-NATO ally" to fit particular countries that enjoy a unique status. Ireland, for example, is the only member of the European Economic Community that is not a signatory to the NATO Treaty. It is a country whose economy dictates that it work hard to "bring in more business". Its workforce in the technology area is highly trained, reliable and ready. The universities in Ireland are specifically focused on assisting economic growth and providing a workforce for business. While labor costs cannot match that of Korea, China or the Phillipines, it is the lowest in Europe. In short, it provides an atmosphere which is capable

of providing an atmosphere which is capable

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of conducting sophisticated R&D in a cost effective environment  
willing to provide financial incentives attractive to  
business. The Nunn initiatives can work there.

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CHAPTER IV

SOME CONCLUSIONS

If one is to accept that cooperative R&D to build a more capable NATO is a good idea, the assumption from the U.S. point of view should be that it will benefit this nation, that it will be in our best interests to ensure that initiatives begun by Senator Nunn are continued and improved. Without consideration of the current status of readiness of NATO, for that is another subject entirely, one could arrive at support for these initiatives simply on the basis of "improvements for the future."

Providing monies and political support for cooperative R&D begins a process of discovery of differences, misunderstandings and clear requirement for patience. The Nunn initiatives dictate a long view. Research and development of complex ideas take time. There is willingness on the part of European industry to partake of this opportunity, but inherent distrust and healthy skepticism remain. Europe is not certain that the U.S. is really serious about these initiatives nor that it has the patience to wait and see projects begun in FY 1987 through to their conclusion. There is no Nunn Amendment in Europe. European partners are independent entities with budget priorities that vary much as those of our various states. Change comes slowly and not without political cost.

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DOD POSITION

These initiatives regarding R&D are new, and they will require time to digest and funding sustained over several fiscal years to become institutionalized. Efforts begun by various components of DOD will have to have the support and backing necessary to keep positions filled, and in some cases expanded, if work is to be done thoroughly. The start has been impressive. U.S. military officers will need time to build the necessary relationships with European contacts to ensure their mission effectiveness. Again the long view is encouraged.

Europe will have to undertake cooperation with these initiatives by increasing its own resource base. Funding for R&D will have to be increased as will the amount of risk undertaken by private firms. NATO allies will have to treat seriously the issue of "Tech Transfer" and work to improve security and care in those areas where agreement on the need for protection is mutual. The U.S. will have to review its policies with regard to Arms Control matters so as not to stifle R&D opportunities. In those areas of legitimate difference, patience and understanding will have to be the guides to work through sensibly, on a case by case basis, the details of difference to see where accommodation can be reached. Undoubtedly there will be instances of disagreement and the need to move on the order of the day. Again, the overall perspective is what is necessary to keep the initiatives alive. The following are offered for consideration:

--The U.S. must work hard to convince its European counterparts that it is serious about these new initiatives and will stay the course.

CONCLUSION



# DEFENSE

--The Congress should endeavor to take the long view of this program and sustain it with continued and expanded funding and political support.

--The issue of "Technology Transfer" must be reviewed in the U.S. Government with an eye toward reasonable relaxation and treatment of proposed projects in the R&D field with a positive inclination vice a restrictive one.

--European governments must commit more of their budgetary resources toward R&D.

--European firms as well as those within the U.S. should actively seek the assistance of their respective Ministries of Defense to facilitate the introductory process to take advantage of these new initiatives. Once accomplished, these firms should push their governments hard for quick reaction to requests on the part of the U.S. for signed Memoranda of Understanding.

The above points serve as the minimum factors of a formula for success of these initiatives. Cooperation in the R&D area is essential for NATO's conventional warfare needs in the future.

The Alliance needs improvement. Military technology is a fast moving and competitive creature. Cooperation, the core of NATO's reason for being, must be extended seriously at the cutting edge of readiness, R&D. The security of western Europe depends on it.

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2. US/European Economic Co-operation in Military and Civilian Technology, 1974, Thomas J. Callaghan.
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4. Ibid.
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7. "Allied R&D", Armed Forces Journal; December 1986.
8. Ibid.
9. Statement made by Ambassador David M. Abshire in an interview with Charles D. Odorizzi of Armed Forces Journal.
10. Ibid.
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13. Ibid.

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**SEC. 1103. NATO COOPERATIVE RESEARCH AND DEVELOPMENT**

**(a) FINDINGS.—The Congress hereby finds—**

**(1) that for more than a decade the member nations of the North Atlantic Treaty Organization (NATO) have provided in the aggregate significantly larger resources for defense purposes than have the member nations of the Warsaw Treaty Organization;**

**(2) that, despite this fact, the Warsaw Treaty Organization member nations have produced and deployed many more major combat items such as tanks, armored personnel carriers, artillery pieces and rocket launchers, armed helicopters, and tactical combat aircraft than have the member nations of NATO; and**

**(3) that a major reason for this discouraging performance by NATO is inadequate cooperation among NATO nations in research, development, and production of military end-items of equipment and munitions.**

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(b) **CONGRESSIONAL REQUEST FOR COOPERATION ON R&D.**—The Congress, therefore, urges and requests the President, the Secretary of Defense, and the United States Representative to the North Atlantic Treaty Organization to pursue diligently opportunities for member nations of NATO to cooperate—

(1) in research and development on defense equipment and munitions; and

(2) in the production of defense equipment, including—

(A) coproduction of conventional defense equipment by the United States and other member nations of NATO; and

(B) production by United States contractors of conventional defense equipment designed and developed by other member nations of NATO.

(c) **FUNDS FOR COOPERATIVE PROJECTS.**—(1) Of the funds appropriated pursuant to the authorizations in section 201(a) \$200,000,000 shall be available, in equal amounts, to the Army, Navy, Air Force, and Defense Agencies only for NATO cooperative research and development projects as provided in this section.

(2) As used in this section, the term “cooperative research and development project” means a project involving joint participation by the United States and one or more other member nations of NATO under a memorandum of understanding (or other formal agreement) to carry out a joint research and development program—

(A) to develop new conventional defense equipment and munitions; or

(B) to modify existing military equipment to meet United States military requirements.

(d) **RESTRICTIONS.**—(1) A memorandum of understanding (or other formal agreement) to conduct a cooperative research and development project may not be entered into unless the Secretary of Defense determines that the proposed project enhances the ongoing multinational effort to improve NATO’s conventional defense capabilities through the application of emerging technology.

(2) The Secretary may not delegate the authority to make a determination under paragraph (1) except to the Deputy Secretary of Defense or the Under Secretary of Defense for Research and Engineering.

(e) **RESTRICTIONS ON PROCUREMENT OF EQUIPMENT AND SERVICES.**—In order to assure substantial participation on the part of other member nations of NATO in approved cooperative research and development projects, funds made available under subsection (c) for such projects may not be used to procure equipment or services from any foreign government, foreign research organization, or other foreign entity.

(f) **COOPERATIVE OPPORTUNITIES DOCUMENT.**—(1)(A) In order to ensure that opportunities to conduct cooperative research and development projects are considered during the early decision points in the Department of Defense’s formal development review process in connection with any planned project of the Department of Defense, the Under Secretary of Defense for Research and Engineering shall prepare a formal arms cooperation opportunities document for review by the Defense Systems Acquisition Review Council at its formal meetings.

(B) The Under Secretary shall also prepare an arms cooperation opportunities document for review of each new project for which a Justification of Major Systems New Start document is prepared.

(2) The formal arms cooperation opportunities document referred to in paragraph (1) shall include the following:

(A) A statement indicating whether or not a project similar to the one under consideration by the Department of Defense is in development or production by one or more of the other NATO member nations.

(B) If a project similar to the one under consideration by the Department of Defense is in development by one or more other member nations of NATO, an assessment by the Under Secretary of Defense for Research and Engineering as to whether that project could satisfy, or could be modified in scope so as to satisfy, the military requirements of the project of the United States under consideration by the Department of Defense.

(C) An assessment of the advantages and disadvantages with regard to program timing, developmental and life cycle costs, technology sharing, and Rationalization, Standardization, and Interoperability (RSI) of seeking to structure a cooperative development program with one or more other NATO member nations.

(D) The recommendation of the Under Secretary of Defense for Research and Engineering as to whether the Department of Defense should explore the feasibility and desirability of a cooperative development program with one or more other member nations of NATO.

(g) SIDE-BY-SIDE TESTING.—(1) It is the sense of Congress—

(A) that the Department of Defense should perform more side-by-side testing of conventional defense equipment manufactured by the United States and other member nations of NATO; and

(B) that such testing should be conducted at the late stage of the development process when there is usually only a single United States prime contractor.

(2) In addition to any funds appropriated for activities of the Director of Defense Test and Evaluation pursuant to section 201(a), \$50,000,000 shall be available to the Director, from any other funds appropriated to the Department of Defense for fiscal year 1986, for the acquisition of items of the type specified in paragraph (3) manufactured by other member nations of NATO for side-by-side comparison testing with comparable items of United States manufacture.

(3) Items that may be acquired by the Director of Defense Test and Evaluation under paragraph (2) include the following:

- (A) Submunitions and dispensers.
- (B) Anti-tank and anti-armor guided missiles.
- (C) Mines, for both land and naval warfare.
- (D) Runway-cratering devices.
- (E) Torpedoes.
- (F) Mortar systems.
- (G) Light armored vehicles and major subsystems thereof.
- (H) Utility vehicles.
- (I) High-velocity anti-tank guns.
- (J) Short-Range Air Defense Systems (SHORADS).
- (K) Mobile air defense systems and components.

(4) The Director of Defense Test and Evaluation shall notify the Committees on Armed Services and on Appropriations of the Senate and House of Representatives of his intent to obligate funds made

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available to carry out this subsection not less than 30 days before such funds are obligated.

(5) Not later than February 1 of each year, the Director of Defense Test and Evaluation shall submit to the Committees on Armed Services and on Appropriations of the Senate and House of Representatives a report—

(A) on the systems, subsystems, and munitions produced by other member nations of NATO that were evaluated during the previous fiscal year by the Director; and

(B) on the obligation of any funds under this subsection during the previous fiscal year.

(h) SECRETARY TO ENCOURAGE SIMILAR NATO PROGRAMS.—The Secretary of Defense shall encourage other member nations of NATO to establish programs similar to the one provided for in this section.

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## APPENDIX B

## U.S. FUNDING FOR NUNN AMENDMENT PROJECTS\*

(Millions of Current Dollars)

	FY86	FY87	FY88-92	FY86-92
<b>Army</b>				
Airborne Radar Demonstrator System (ARDS)	\$ 1.5	\$13.1	\$ 3.1	\$ 17.7
155 mm Autonomous Precision-Guided Munition (APGM)	0.6	2.8	25.2	28.6
NATO Identification System (NIS)	10.1	6.4	59.3	75.8
Evolutionary Surface-to-Air Missile/Medium Surface-to-Air Missile (ESAM/MSAM)	2.5	20.0	145.8	168.3
Hawk Mobility Enhancement (HME)	5.0	3.0	-	8.0
<b>Total</b>	<b>\$19.7</b>	<b>\$45.3</b>	<b>\$233.4</b>	<b>\$298.4</b>
<b>Navy</b>				
New-Generation Mines	\$ 5.5	\$ 6.0	\$121.7	\$133.2
NATO Frigate Replacement-90	2.0	4.1	24.0	30.1
NATO Anti-Air Warfare Link-II Improvements	6.0	18.5	115.7	140.2
NATO Identification System	0.4	3.2	56.6	60.2
NATO Seasparrow	3.3	2.5	303.4	309.2
NATO Surface Ships' Torpedo Defense (SSTD)	2.7	4.0	62.7	69.4
Contractual Support (to assist in establishing and managing cooperative programs)	-	2.0	203.8	205.8
	2.1	-	-	2.1
<b>Total</b>	<b>\$22.0</b>	<b>\$40.3</b>	<b>\$887.9</b>	<b>\$950.2</b>
<b>Air Force</b>				
NATO Identification System	\$ 9.5	\$ 3.5	\$345.3	\$358.3
Modular Standoff Weapons	14.3	30.0	90.3	134.6
<b>Total</b>	<b>\$23.8</b>	<b>\$33.5</b>	<b>\$435.6</b>	<b>\$492.9</b>
<b>Defense Agencies &amp; DOD Wide</b>				
Ada Project Support Environments (PSE)	\$ 4.0	\$ 4.0	\$ -	\$ 8.0
Multifunctional Information Distribution System (MIDS)	5.0	\$10.0	57.0	72.0
Enhanced Fighter Maneuverability	8.0	25.0	45.0	78.0
Advanced Short Takeoff and Vertical Landing (ASTOVL)	7.0	12.0	35.0	54.0
Battlefield Information Collection & Exploitation Systems (BICES)		21.6	118.7	140.3
<b>Total</b>	<b>\$24.0</b>	<b>\$72.6</b>	<b>\$255.7</b>	<b>\$352.3</b>
<b>DOD Total *</b>	<b>\$89.5*</b>	<b>\$191.7*</b>	<b>\$1,812.6*</b>	<b>\$2,093.8*</b>

\*Does not include funding for side-by-side testing  
Source: DOD

## APPENDIX C

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## NATO COMPARATIVE TEST PROGRAMS

<u>Programs</u>	<u>Country</u>	<u>\$ in Millions</u>	
		<u>FY86</u>	<u>FY87</u>
<b>Army</b>			
NBC Reconnaissance Vehicle	Germany	\$1.300	-
Mine Recon & Detection System	Germany	1.100	-
Mistral Air Defense System	France	7.000	-
<b>Navy</b>			
Advanced Integrated MAD	France, Canada	.736	\$ .637
90mm Gun for LAV	Belgium	.800	2.000
Air Defense System Displays	UK	.400	.100
NATO ID System RM Interrogator	UK	1.820	.970
2.75" Penetrating Warhead	Norway, Canada	.600	1.200
Naval Depth Sounder	Germany	.250	.260
Submarine Periscope	UK, Germany, France	.450	.465
Insensitive 2.75" Rocket Motor	France	1.100	-
Osborne Minehunter	UK	2.100	.250
Cryogenic Cooling System	Netherlands	.580	.560
<b>Air Force</b>			
Penguin Missile	Norway	1.600	1.600
Cratering Munition Fuze	France	.040	.445
Flail System	UK	.480	-
Hades Munition Dispenser	UK	.115	.050
Millimeter Wave Seeker	UK	2.000	4.000
Flare/Chaff Dispenser Switch	Denmark	.200	-
<b>Totals: 19 Programs, 22 Systems, 8 NATO countries</b>		<b>\$22.671</b>	<b>\$12.537</b>

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APPENDIX D

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U.S. ELECTRONICS FIRMS DOING BUSINESS IN IRELAND

Accuracy Corporation, Columbus, Ohio  
Electronic process control equipment for the paper, pulp,  
plastic, cigarette, carpet industries.

Adda Corporation, Los Gatos, California  
Electronic equipment for broadcasting industry.

Allis Chalmers Corporation, West Allis, Wisconsin  
Airconditioning and heat recovery equipment.

Amdahl Corporation, Sunnyvale, California  
Computers.

American Standard Inc., New York  
Railroad Signalling Equipment.

Analog Devices Incorporated, Norwood, Massachusetts  
CMOS integrated circuits.

Apple Computer Incorporated, Goleta, California  
Personal Computers.

Applied Magnetics Corporation, Goleta, California  
Digital magnetic tape heads for export.

Applied Technology Ventures, Sunnyvale, California  
Micro-computers.

AT & T International, Basking Ridge, New Jersey  
Telecommunication products.

Beehive International, Salt Lake City, Utah  
Video display computer terminals.

Bell & Howell Co., Chicago, Illinois  
Film projectors and film equipment.

Bijur Lubrication Corporation, Rochelle Park, New Jersey  
Pumps for lubrication and coolant system

Bose Corporation, Framingham, Massachusetts  
Audio Equipment e.g. loudspeaker systems.

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Bourns Incorporated, Riverside, California  
Potentionmeters

Brookfield Engineering Laboratories Incorporated, Stoughton,  
Massachusetts  
Visometers and associated products.

Burroughs Corp., Detroit, Michigan  
Audio cassettes and flexible disks.

Carten Systems Incorporated, Danbury, Connecticut  
Control valves and regulators for use in high purity gas  
systems.

Centronics Data Computer Corporation, Hudson, New Hampshire  
Printers and interfaces.

Compugraphic Corporation, Wilmington, Massachusetts  
Typesetting equipment.

Computer Automation Incorporated, Boulder, Colorado  
Digital min-computers and systems.

Computer Products Inc., Fort Lauderdale, Florida  
Linear and switching power supplies.

CPT Corporation, Eden Prairie, Minnesota  
Word processors.

Data Products, Woodland Hills, California  
Line printers for computer industry.

Digital Equipment Corporation, Maynard, Massachusetts  
Mini-computers and peripherals.

Filex Corporation, Downers Grove, Illinois  
Smoke detectors.

Floating Point Systems Incorporated, Portland, Oregon  
Scientific computer systems.

Gelman Sciences Incorporated, Ann Arbor, Michigan  
Filtration and membrane products. Table-top water purification  
instruments.

General Electric Co., Fairfield, Connecticut  
Integrated circuits, semiconductors, electronic components,  
smoke alarms, silicon control rectifiers, TV electron guns,  
lamp components.

General Motors Corporation, Detroit, Michigan  
Electric wiring harnesses for cars.

General Signal Corporation, Stamford, Connecticut  
Industrial recorders and analysis instrumentation.

Gould Incorporated; Rolling Meadows, Illinois  
Computer systems.

Gow-Mac Instrument, Bound Brook, New Jersey  
Scientific measuring instruments and gas analysis apparatus.

GTI, San Diego, California  
Components for the computer and semi-conductor industries.

HCC Industries, Encino, California  
Electrical transformers for computers.

Informer Incorporated, Los Angeles, California  
Computer terminals.

Intertec Data Systems, Columbia, South Carolina  
Computer video terminals.

Koss Corporation, Milwaukee, Wisconsin  
Stereo headphones and accessories.

Liebert Corporation, Columbus, Ohio  
Stabilized power supply systems and special air conditioning  
units for computer industry.

MDB Systems Incorporated, Orange, California  
Computer interface products.

Measurex Corporation, Cupertino, California  
Digitally controlled equipment.

Milton Bradley Co., Springfield, Massachusetts  
Electrical/electronic toys.

Milton Roy Company, St Petersburg, Florida  
Analytical data processing equipment.

Modular Computer Systems Inc., Fort Lauderdale, Florida  
Mini-computer systems.

Molex Incorporated, Lisle, Illinois  
Electronic connectors and terminals.

Moog Incorporated, New York  
Electro-hydraulic servo valves.

North Star Computers Inc., San Leandro, California  
High performance desk-top computers.

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The O'Brien Machinery Co., Downingtown, Pennsylvania  
Generating equipment (electrical equipment).

Orth Kinetics Incorporated, Waukesha, Wisconsin  
Invalid chairs.

Pako Corporation, Minneapolis, Minnesota  
Range of graphic arts, X-Rays and photoprocessing machinery.

Panametrics Incorporated, Waltham, Massachusetts  
Hygrometers and other electronic measuring equipment.

Perkin Elmer Corporation, Norwalk, Connecticut  
Mini-computer systems

Prime Computer Inc., Natick, Massachusetts  
Computer systems.

Reliability Incorporated, Houston, Texas  
Voltage convertors.

Revlon Inc., New York  
Instruments for automatic chemical analysis.

Shop Vac Corporation, Williamsport, Pennsylvania  
Wet/dry vacuum cleaners.

A O Smith Corporation, Milwaukee, Wisconsin  
Specialist electric motors.

Square D Company, Palatine, Illinois  
Semi-conductors, silicon compressors, electrical and control  
equipment(miniature circuit breaker).

Storage Technology Corporation, Louisville, Colorado  
Computer line printer sub-system.

Timeplex Incorporated, Rochelle Park, Illinois  
Data communication equipment.

Trilogy Systems Corp., Cupertino, California  
High performance mainframe computers.

United Technologies Corporation, Hartford, Connecticut  
Integrated circuits (both memory devices and micro-processors).

Unitrode Corporation, Lexington, Massachusetts  
Semi-conductors.

Varian Associates, Palo Alto, California  
Electronic components.

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Verbatim Corporation, Sunnyvale, California  
Magnetic discs and tapes and R & D facility.

Wang Laboratories, Inc., Lowell, Massachusetts  
Computer systems, work processing systems and related  
peripheral devices.

Warner Communications Incorporated, New York  
Electronic amusement games.

Western Digital Corp., Irvine, California  
Assembly and disk controllers.

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania  
Intelligence computer terminals, electronic products design and  
manufacture, vacuum interrupters, process control instruments  
and systems; computer energy management systems, switchgear.

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Special Assistant for International Co-operative R&A  
Office of the Deputy Chief of Staff Research  
Development and Acquisition.
  - Dr. George Rose  
Technical Staff Officer to Dep Head British Defense  
Staff  
British Embassy, Washington, D.C.
  - Colonel Franklin W. Watkins, USAF  
Military Assistant  
Special Advisor for NATO Armaments  
Deputy Secretary of Defense
  - Algirdas J. Rimas  
First Secretary, Economic and Commercial Affairs  
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