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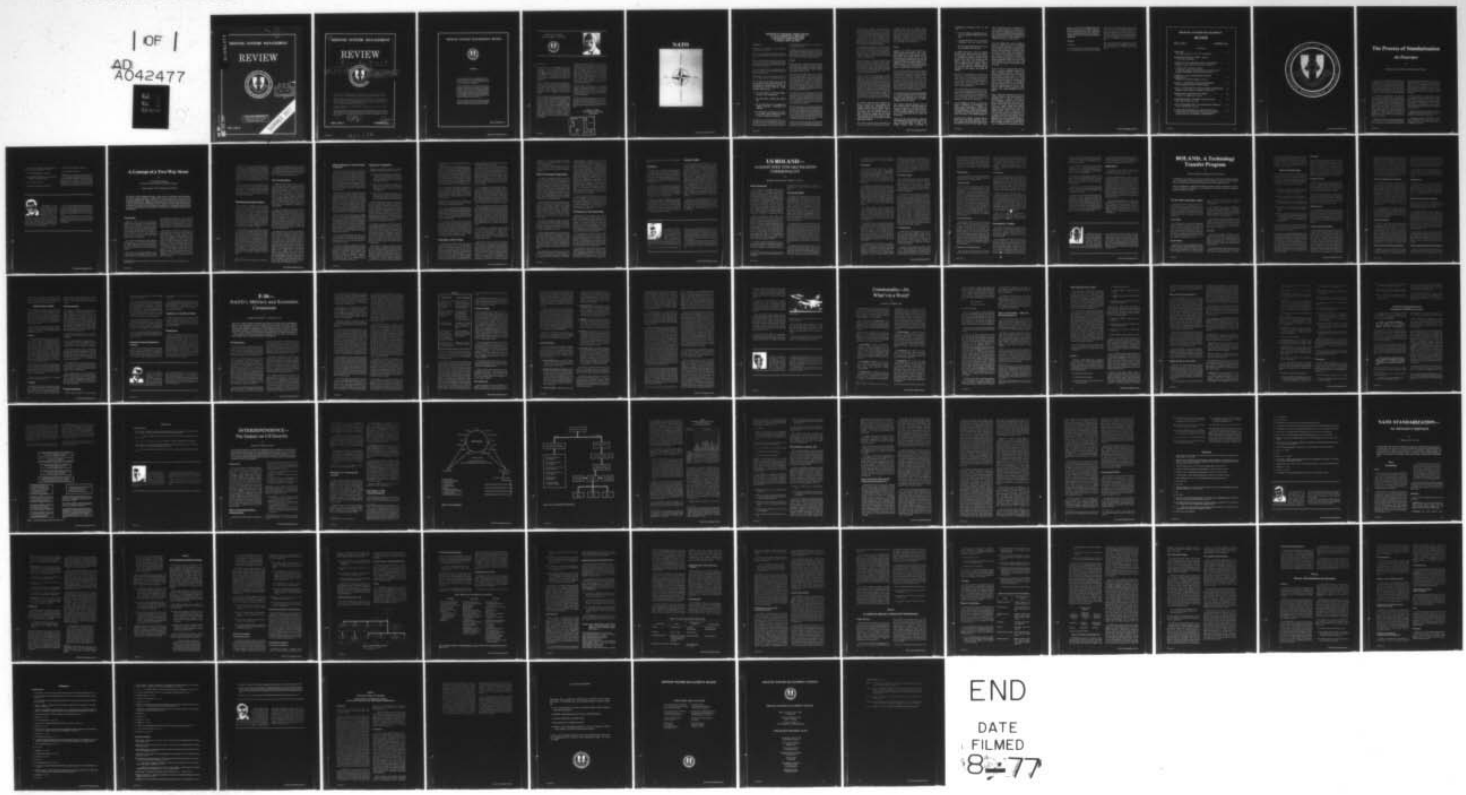

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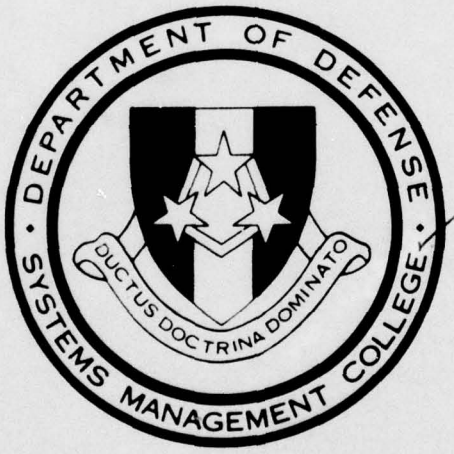

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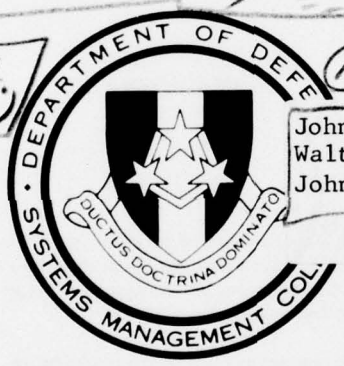

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DEFENSE SYSTEMS MANAGEMENT REVIEW

PURPOSE

The purpose of the Defense Systems Management Review is to disseminate information concerning new developments and effective actions taken relative to the management of defense systems programs and defense systems acquisition.

The Review is designed as a vehicle to transmit, between persons in positions of leadership and responsibility in the program management and systems acquisition communities, information on policies, trends, events and current thinking affecting the practice of program management and defense systems acquisition. The publication serves as a means for providing an historical record of significant information associated with defense systems acquisition/management concepts and practices.

The Review supports the assigned mission of the Defense Systems Management College, and serves as a medium for continuing the education and professional development of persons in the field.

Review: US ISSN 0363-7727

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

Dear Reader:

Volume 1, Number 3, of the DSM Review is devoted principally to a series of articles about standardization within the North Atlantic Treaty Organization (NATO). Four articles were generated at the behest of Mr. William E. Stoney, Office of the Director of Defense Research and Engineering, who initiated the series. Brigadier General Frank J. Palermo guided the DDR&E effort.

By a most fortunate concurrence of circumstance we are able to present "A Concept of a Two-Way Street," by Dr. Walter B. LaBerge, Assistant Secretary General for Defense Support, NATO. The article by Dr. LaBerge has a definite relation to the articles about standardization and is a highlight of this issue of the Review.

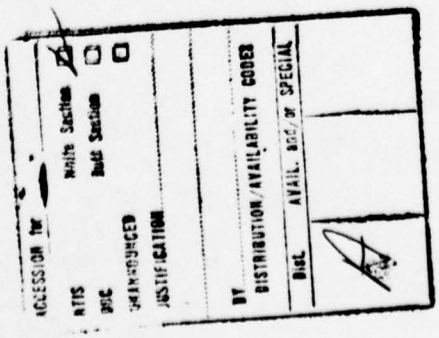
For the first time we are presenting articles prepared by two program managers, Brigadier Generals Frank Ragano, US Army and James C. Abrahamson, US Air Force. These articles are complemented by an interesting article authored by an eminently qualified member of industry, Mr. John Richardson, Hughes Aircraft Company. On behalf of the entire program management community I express gratitude and thanks to all distinguished contributors who have shared their experiences and expertise so that program managers and systems acquisition managers of the Department of Defense can benefit from them to the maximum.

I announce with pleasure that we now have our full complement of Associate Editors for the DSM Review. General Jack Catton, USAF (Ret), Lockheed Aircraft Corporation, Professor John W. Fondahl, Stanford University, Mr. Eric Jenett, Brown & Root, Inc., and General Samuel C. Phillips, USAF (Ret), TRW, Inc., all have agreed to serve, along with Messrs. Augustine, Malloy, Sullivan and Welch identified in the last issue. In the capacity of Associate Editor these eminent practitioners of program management and systems acquisition management serve a most important function.

With deep regret I report the loss of an important member of the Associate Editor team, Lt Gen John O'Neill, USAF (Ret). The demise of Lt Gen O'Neill saddened those of us who had been privileged to work with him and who have lost the benefit of his guidance and judgment.

At this time I take the opportunity to extend a heartfelt welcome to Rear Admiral Rowland G. Freeman, III, USN, who has been designated as the next Commandant of the Defense Systems Management College. Admiral Freeman will succeed me on 1 July 1977.

JOHN G. ALBERT
Major General, US Air Force
Commandant



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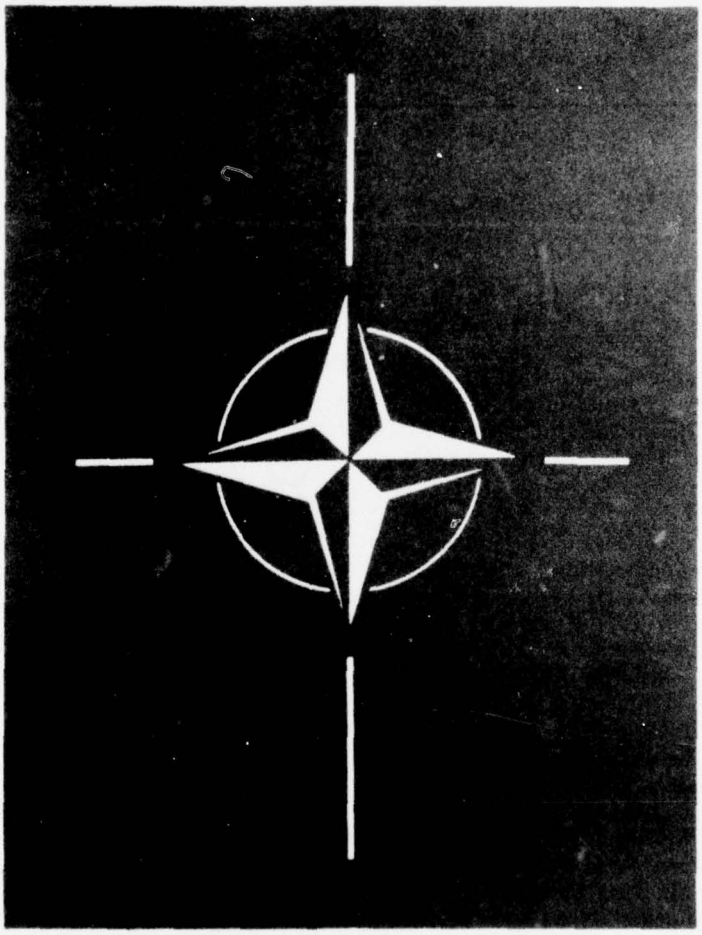

REMARKS OF PRESIDENT JIMMY CARTER AT NATO MINISTERIAL MEETING LANCASTER HOUSE, ENGLAND TUESDAY, MAY 10, 1977

Introduction

Mr. President, Mr. Secretary General, Excellencies, and Members of the Council:

We meet at an important time in the development of the international institutions on which our countries rely.

Here in London last week the leaders of seven nations and of the Commission of the European Communities pledged to join others in strengthening these institutions in the economic field.

Today and tomorrow this Council will discuss how to adapt the Alliance to meet the military and political challenges of the 1980's.

Taken together, these meetings should give new impetus to relations among our industrial democracies.

At the center of this effort must be strong ties between Europe and North America. In maintaining and strengthening these ties, my Administration will be guided by certain principles. Simply stated:

- **We will continue to make the Alliance the heart of our foreign policy.**
- **We will remain a reliable and faithful ally.**
- **We will join with you to strengthen the Alliance—politically, economically and militarily.**
- **We will ask for and listen to the advice of our Allies. And we will give our views in return, candidly and as friends.**

This effort rests on a strong foundation. The state of the Alliance is good. Its strategy and doctrine are solid. We derive added strength and new pride from the fact that all fifteen of our member countries are now democracies. Our Alliance is a pact for peace—*and* a pact for freedom.

The Alliance is even stronger because of solid progress toward Western European unification and the expanding role of the European Community in world affairs. The United States welcomes this development, and will work closely with the Community.

Political

In the aftermath of World War II, the political imperatives were clear: to build the strength of the West and to deter Soviet aggression. Since then East-West relations have become far more complex. Managing them requires patience and skill.

Our approach to East-West relations must be guided both by a humane vision and by a sense of history. Our humane vision leads us to seek broad cooperation with Communist states for the good of mankind. Our sense of history teaches us that we and the Soviet Union will continue to compete. Yet if we manage this dual relationship properly, we can hope that cooperation will eventually overshadow competition, leading to an increasingly stable relationship between our countries and the Soviet Union.

The United States is now discussing with the Soviet Union ways to control strategic arms. By involving the Soviet Union in a continuing effort to reduce and eventually to eliminate nuclear weapons we hope not only to minimize the risks and costs of continuing arms competition but also to promote broader cooperation between our countries.

The Soviet Union has not yet accepted our proposals. But it has made clear that it wants an agreement. We will persevere in seeking an early and a genuine end to the arms race, through both a freeze on modernization of strategic weapons and substantial reductions in their number. And as we pursue this goal, we will continue to consult with you fully—not only to keep you informed but also to seek your views.

I hope that our countries can also reach agreement with the Soviet Union in limiting and reducing conventional forces. The United States strongly supports

the efforts of the Alliance to gain an accord on mutual and balanced reduction of forces in Central Europe. That agreement should be based on parity in force levels through overall ceilings for the forces of NATO and the Warsaw Pact. The Soviet Union, by contrast, seeks to preserve the present conventional imbalance and to impose national force ceilings. I hope that these obstacles can be overcome. MBFR must be a means for achieving mutual security, not for gaining one-sided military advantage.

As we pursue arms control with the Soviet Union and the Warsaw Pact, we should also try to draw the nations of Eastern Europe into cooperative undertakings. Our aim is not to turn this region against the Soviet Union, but to enlarge the opportunities for all European countries to work together in meeting the challenges of modern society.

Next month delegates of 35 countries will confer in Belgrade to plan for a meeting to review progress since the Helsinki Final Act. The United States shares with you a desire to make this a useful and constructive meeting. We support a careful review of progress by *all* countries in implementing all parts of the Final Act. We approach these meetings in a spirit of cooperation, not of confrontation.

America's concern for human rights does not reflect a desire to impose our particular political or social arrangements on any other country. It is, rather, an expression of the most deeply felt values of the American people. We want the world to know where we stand. (We entertain no illusion that the concerns we express and the actions we take will bring rapid changes in the policies of other governments. But neither do we believe that world opinion is without effect.) We will continue to express our beliefs—not only because we must remain true to ourselves, but also because we are convinced that the building of a better world rests on each nation's clear expression of the values that have given meaning to its national life.

In all these tasks and others facing the Alliance, it is vital for us to work together—particularly through close consultation and cooperation with the North Atlantic Council. We do not need new institutions, only to make better use of one that has served us so well. To this end I pledge that the United States will share with the Council our views and intentions about the full range of issues affecting the Alliance.

The Council should also examine long-range problems, so as to make this consultation more effective. A special Alliance review of East-West relations, undertaken by the Council and drawing in national experts, could serve this end. Such a review might assess future trends in the Soviet Union, in Eastern Europe and in East-West relations, and analyze the implications of these trends for the Alliance. The United States is prepared to make a major contribution to this study, whose conclusions could be considered at the May 1978 NATO meeting.

Defense

Achieving our political goals depends on a credible defense and deterrent. The United States supports the existing strategy of flexible response and forward defense. We will continue to provide our share of the powerful forces adequate to fulfill this strategy. We will maintain an effective strategic deterrent, we will keep diverse and modern theatre nuclear forces in Europe, and we will maintain and improve conventional forces based here.

The threat facing the Alliance has grown steadily in recent years. The Soviet Union has achieved essential strategic nuclear equivalence. Its theatre of nuclear forces have been strengthened. The Warsaw Pact's conventional forces in Europe emphasize an offensive posture. These forces are much stronger than needed for any defense purpose. Since 1965, new ground and air weapons have been introduced in most major categories: self-propelled artillery, mobile tactical missiles, mobile air defense guns, armored personnel carriers, tactical aircraft, and tanks. The pace of the Pact's buildup continues undiminished.

Let me make it clear that our first preference is for early agreement with the Soviet Union on mutual and balanced force reductions. Failing to reach this agreement, our military strength must be maintained.

The collective deterrent strength of our Alliance is effective. But it will only remain so if we work to improve it. The United States is prepared to make a major effort to this end—as Vice President Mondale told you in January—in the expectation that our Allies will do the same.

There have been real increases in allied defense spending. But difficult economic conditions set practical limits. We need to use limited resources wisely, particularly in

strengthening conventional forces. To this end:

- We must combine, coordinate, and concert our national programs more effectively.
- We must find better ways to bring new technology into our armed forces.
- We must give higher priority to increasing the readiness of these forces.

To fulfill these goals, I hope our Defense Ministers, when they meet next week, will begin developing a long-term defense program to strengthen the Alliance's deterrence and defense in the 1980's. That program should help us make choices and set priorities. It should emphasize greater Alliance cooperation to ensure that our combined resources are used most effectively. It should take full advantage of work already done within the Alliance.

But plans are not enough. We must ensure that our Alliance has an adequate means for setting overall goals in defense, for measuring national performance against these goals, and for devising and carrying out joint programs. I propose that our Defense Ministers, working closely with the Secretary General, consider how best to strengthen the Alliance's ability actually to fulfill agreed programs.

After an interim report to the December 1977 meeting, I hope the Defense Ministers will submit their program to the Spring Meeting which might be held at the Summit to review their recommendations. I also hope the Defense administrators will agree next week to make high priority improvements in the capabilities of our forces over the next year.

As we strengthen our forces, we should also improve cooperation in development, production and procurement of Alliance defense equipment. The Alliance should not be weakened *militarily* by waste and overlapping. Nor should it be weakened *politically* by disputes over where to buy defense equipment.

In each of our countries, economic and political factors pose serious obstacles. None of our countries, the United States included, has been free from fault. We must make a major effort—to eliminate waste and duplication between national programs; to provide each of our countries an opportunity to develop, produce and sell competitive defense equipment; and to maintain technological excellence in all Allied combat forces. To reach these goals our countries will need to do three things:

First, the United States must be willing to promote a genuinely two-way trans-Atlantic trade in defense equipment. My Administration's decisions about the development, production and procurement of defense equipment will be taken with careful attention to the interests of all members of the Alliance. I have instructed the Secretary of Defense to seek increased opportunities to buy European defense equipment where this would mean more efficient use of Allied resources. I will work with the Congress of the United States to this end.

Second, I hope the European allies will continue to increase cooperation among themselves in defense production. I welcome the initiative taken by several of your countries in the European Program Group. A common European defense production effort would help to achieve economies of scale beyond the reach of national programs. A strengthened defense production base in Europe would enlarge the opportunities for two-way trans-Atlantic traffic in defense equipment, while adding to the overall capabilities of the Alliance.

Third, I hope that European and the North American members of the Alliance will join in exploring ways to improve cooperation in the development, production and procurement of defense equipment. This joint examination could involve the European Program Group as it gathers strength and cohesion. Some issues could be discussed in the North Atlantic Council. Whatever the forum, the United States is ready to participate in the way and at the pace that our allies wish. We are eager to join with you in trying to identify opportunities for joint development of new equipment and for increasing licensing or direct purchase of equipment that has already been developed. Together, we should look for ways to standardize our equipment and make

sure it can be used by all allied forces. We should see if ways can be found to introduce into our discussions a voice that would speak for the common interests of the Alliance in offering advice about cooperation in defense equipment.

Conclusion

To conclude:

It is not enough for us to share common purposes; we must also strengthen the institutions that fulfill those purposes. We are met today to renew our dedication to one of the most important of those institutions, and to plan for actions that will help it to meet new challenges. Some of these actions can be taken in the near future. Others can be developed for review at our meeting next year at this time. I would be glad to offer Washington as the site of that meeting.

The French writer and aviator, Saint-Exupery, wrote that "the noblest task of mankind is to unite mankind." In that spirit, I am confident that we will succeed.

DEFENSE SYSTEMS MANAGEMENT REVIEW

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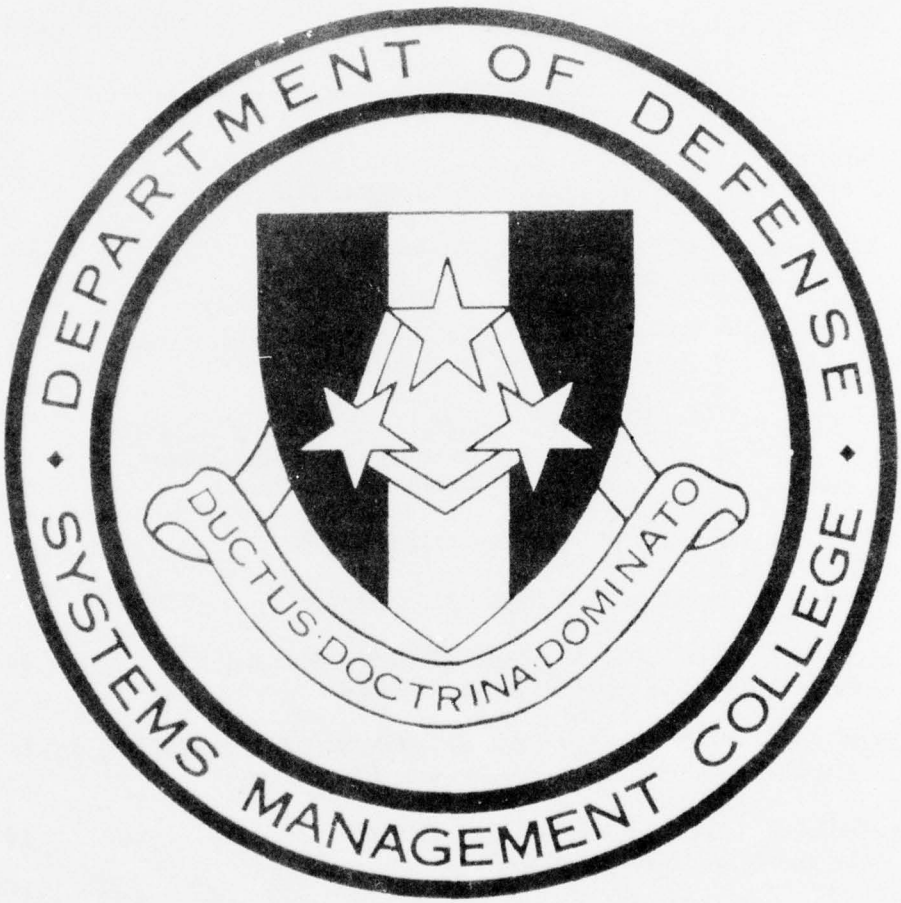
DEPARTMENT OF DEFENSE
SYSTEMS MANAGEMENT COLLEGE
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The Process of Standarization

An Overview

by

William E. Stoney, Office of the Secretary of Defense

The purpose of this discussion of the process of standardization is to shed some light on the process to guide both policy makers and system developers in the value of continuing the process. Further, some "lessons learned" are provided for those who will be pioneering new programs in the future. To this end a series of articles are presented. Advantages and disadvantages of the existing process are described.

A definition of standardization and interoperability and some general benefits are discussed by Colonel Waddell. These items and associated policy have recently been reinforced and clarified by DOD Directive NUMBER 2010.6, "Standardization and Interoperability of Weapon Systems and Equipment within the North Atlantic Treaty Organization," dated 11 March 1977. (I encourage you to become familiar with this Directive, to use it as a guide, and to suggest improvements to it.) The article by Colonel Waddell also clearly highlights the advantage of standardization in items such as fuel, ammunition and high-rate consumables.

The Roland articles are case studies including both the experience of the Government Project Manager and a senior industry Vice President. There are many lessons but the bottom line reflects a savings of from $500 to $800 million in the development phase of this system. The cost savings probably will never make its way into the ledger, but it is there. The other lessons of the Roland story include those of licensing and interoperability and should be taken into consideration if you are embarking on similar programs.

The F-16 program is an ongoing, dynamic example of a coproduction effort of a highly complex weapon system. The F-16 program is one of the most important and successful programs within NATO to achieve the benefits of standardization. The experience gained from overcoming significant barriers in national industrial differences and currency exchange is worthy of review.

Further, joint or lead Service Program Offices are becoming more effective as the Services cooperate in programs entering engineering development.

I find there are a number of half-truths and myths about standardization that really didn't come out and get laid to rest in the articles, so I'll lay a few on the table in this overview.

"It is difficult to standardize with the Army, Air Force, Navy, Germans, Hughes, etc., because:

- our REQUIREMENTS are different;
- our SPECIFICATIONS (especially our SAFETY SPECIFICATIONS) are different;
- our drawings are different;
- our manufacturing process is different;
- they are still changing the design; and,
- our cultures are different."

Hopefully, the information presented will assist you in formulating and managing your programs. The material acquisition business is dynamic and innovative. Our job is to provide effective and affordable equipment to the servicemen in the field. Use standardization and interoperability both within the US and NATO to get more effectiveness for the dollar.

Mr. William E. Stoney is the Deputy Director (Tactical Warfare Programs) for the Director of Defense Research and Engineering, Office of the Secretary of Defense, Washington, DC. Mr. Stoney is responsible for the tactical warfare programs of the Army, Navy and Air Force in the mission areas of air warfare, land warfare, ocean control and combat support. Immediately prior to assumption of his present position (Oct 75), Mr. Stoney was the Deputy Assistant Secretary for Systems Development and Technology, Office of the Secretary of Transportation.

Mr. Stoney has had indepth experienee with industry for a period that exceeds 20 years. His last position in industry was that of Executive Advisor to the President, Microelectronic Division, Rockwell International. He served in various positions of great responsibility with Rockwell International (formerly North American Aviation Inc.) both in the US and abroad.

A former Naval Officer, Mr. Stoney received his BSEE (1943) and MSEE (1947) from the University of California, Berkley, where he later served as a Lecturer in Electrical Engineering (1946-51). He completed the UCLA Executive Course in 1966.

A Concept of a Two-Way Street

by

Dr. Walter B. LaBerge
Assistant Secretary General for Defense Support

North Atlantic Treaty Organizations (NATO)

The author, a former Assistant Secretary of the Air Force for Research and Development, has had the unique opportunity of seeing NATO function from inside a nation, and of seeing nations function from inside NATO. He is an astute observer of the research and development problems that challenge the Alliance nations. In this article Dr. LaBerge presents a concept that he believes would make the most effective use of the collective resources of the nations of Europe and the US in their common endeavor. The proposal made represents his private views framed by his experiences. The author is not writing for NATO in any official capacity.*

Introduction

There are myriad research and development (R&D) problems which every day challenge Alliance nations. Airborne Warning and Control Systems (AWACS), next generation surface-to-air missiles, main battle tanks and air-to-air missiles all present different problems and opportunities. The solution to these problems and other future opportunities does require a resolution of how to achieve a meaningful two-way street. I have prepared this article about this concept of a two-way street.

Let me start by discussing the problem addressed by the concept of a two-way street. The problem of the Alliance today has very few historical parallels. The closest parallel is worth exploring because it focuses on what I believe to be our current NATO problem.

Few, if any, of you who are reading this article fought long ago in the campaign of 1916 at Verdun in Northern France. Those contestants who are still living recall that long deadly battle with a mixture of horror, and pride of valour. Few today consider an understanding of the Verdun campaign to be of any importance in this the missile age. Yet, what we are going through now, though bloodless, may gain its closest insight from the desperate battle of Verdun.

Most students of history say that the Battle of Verdun came about in response to the military and political stalemate of 1914-1915. In Europe, in early 1916, the seemingly unbreakable deadlock reached from Ypres in Belgium to the Marne, passed near Verdun and continued to the Swiss border. After nearly 20 months of World War I it seemed to both sides that a decisive, quick breakthrough was not possible, and that this 1916 stalemate of forces might be impossible to break. So, in like manner, it may seem to the Soviet planner of today, as he sees the stalemate of 1977 stretch from the tip of Norway through the length of Europe to the Straits of the Bosphorous. This modern stalemate is also of long standing, and it too, is one for which it is hard to find a quick solution.

*Based upon a presentation before the Conference on the Atlantic Community at Georgetown University, Washington, DC, 14 February 1977.

The solution in 1916, proposed and attempted by General Eric von Falkenkeyn, was to conduct at Verdun a campaign of unending attrition of military and economic resources. The objective of his campaign was to reduce his opponent to submission by an unrelenting exchange of his manpower and economic resources for those of his opponent. For nearly a year (an eternity in battle) this exchange of men and materials took place until neither side could go on any longer.

Nearly a million men were blown apart from the 21st of February 1916 to the close of the battle in the December of that year. The total losses at Verdun are marked at 976,000 soldiers of both sides killed and wounded, and uncounted millions of tons of munitions expended on a front never more than 20 miles wide and 5 miles deep.

Maintaining the Military Balance

The relevance of the Battle of Verdun to the situation of today, is that where there is stalemate, economic and physical attrition may be the only avenues open to an adversary to change the military balance. It seems to me that the Soviets have chosen economic rather than military attrition as a test of the strength of our military and economic systems. Today the Soviets and their Allies choose not battle but continuous threat of battle to try to exhaust our resources to gain a favorable military imbalance. We are, whether we wish it or not, engaged in a long-term economic battle to maintain a military balance just as were Falkenkeyn's adversaries at Verdun.

If this assessment is true, the Alliance must plan for many years of integrated military and economic confrontation. Each day the strength of the Alliance must be great enough to deter attack, but each day it must also prepare for a tomorrow and a tomorrow beyond that when it must be equally able to deter. The Alliance must use its combined resources to buy the most effective military equipment, and do it in a way that keeps the economies of Alliance nations strong each day as far into the future as one can see. It is my thesis in this article today that the nations of the Alliance are not working on this problem of long term military economic cooperation and, that unless they do the Alliance will have very great trouble.

To succeed in this long-term conflict, the nations of the Alliance must decide that it is truly obligatory to work together (which I do not believe they have yet decided) and then to adapt their bureaucratic institutions to work continuously to solve the problems of equitable international cooperation.

The Two-Way Street

Fundamentally, the concept of the two-way street is a concept of economic equity needed for long-term economic stability. Thomas A. Callaghan* coined the phrase "two-way street" a long time ago. He suggested then that efficient use of our resources by all Alliance nations was obligatory, and that the efficient use of resources couldn't be accomplished without economic equity among the participants. From my recent perspective of Brussels, where I sit as an international public servant, I agree. To my mind the military-economic conflict forced upon the Alliance by the Soviets has already demanded economic equity as a condition for cooperation for mutual defense.

Today each Alliance nation must export technological products to counter the outward flow of gold paid for foreign oil. This fact leads nations to want to improve their technology so as to increase their trade. No Alliance nation can plan to buy overseas without economic compensation. No nation wants to reduce the state of its science and technology by purchase of military technology overseas. More and more these considerations dominate military procurement. Indeed most European nations appear to believe that the crisis in their economic futures is as real as the crisis in their military future.

The unbalanced flow of products and technology between America and Europe, in the view of these nations, cannot be allowed to continue. The European members of the Alliance feel that there must be a "two-way street" of economic equity, and that it must be built very, very soon. Whether the street is to have much or little traffic, they do not know, but they believe that in the near future it must be economically balanced. What will flow back and forth equally over this two-way street is not at all clear today. It may be compensating arms procurement as suggested in the original version of the two-way street, it may be a balance of arms one way and offsetting commercial products the other. It may be only licensed drawings and technology flowing each way with independent production staying on each side of the Atlantic, or it may be that there will not be a flow at all. The Alliance says the two-way street will be balanced, and I believe they mean it.

*President of Export-Import Technology, Inc., Washington, DC.

Lack of Dedication Toward Finding A Solution

The pity to me at this crucial time is that there seems to be virtually no effort by those in charge of nations to find a long-term solution for this two-way street. Nations are working together, but only on single programs of the very near future, with not too much success. People write, people talk, people exhort and people tire of the subject of a two-way street across the Atlantic. As far as I can see from my office in Brussels, the leaders of the Alliance are not seriously studying how to provide the environment that allows the nations on each side of the ocean to share their efforts.

The United States, while vigorously advocating standardization of armaments, appears to be ignoring the consequences of the fact that what they are suggesting is based mostly on purchase of US equipment. The US has yet to offer any economically acceptable way to allow NATO the use of these great US research and development efforts. The US examples of proposed cooperation with European nations occur so late in the development cycle that the European sources are necessarily uneconomic. Thus, program by program equitable offsets of technology participation are not possible to bring about.

More and more the European nations are finding that there may be no way to work equitably with the US. To me, an outsider, the European nations seem satisfied that there cannot be close cooperation between Alliance partners on each side of the Atlantic in the development and production of armaments. Believing that traffic from European nations to American will always be small, Europe appears to be heading towards a self-sufficiency in arms development. Europe is becoming independent of the great R&D strength in America.

So to me it seems that although the two-way street will soon become a reality, there may never be any traffic on it. That is not what anyone would want if he thought about it, but it is my contention, that is exactly what may happen.

If allowed to happen, this consequence will result in a gross waste of resources. And worse, it will lead to different and uninteroperable equipments and to difficult and unnecessary logistic problems. This Continental research and development apartheid should not be allowed to happen. To prevent it from happening, the people in charge of Ministries of Defense will have to make something different happen, and they will have to do it now.

Options for Cooperation

Basically, three options are possible for equitable transatlantic cooperation in defense procurement:

(1) The US and Europe can divide equitably procurement of their armaments, one side agreeing to depend on the other side of the Atlantic for a substantial part of their R&D and procurement needs, or,

(2) There can be a balance of US made armaments sold to Europe and US purchase of technically advanced commercial products from Europe, or,

(3) The flow on the two-way street can be primarily a flow of ideas and drawings, with the result that, frequently, the same product will be produced both in the US and Europe.

The last option I believe can work. I do not think the first two options are workable no matter how hard we may try to make them so. In my view, option (2), offsetting US armaments with European commercial products, requires regulation of business on both sides of the Atlantic beyond the realistic ability of either side to implement. In cases where it has been tried there has been only limited success. Furthermore, such an offset concept would destroy substantially the financial base for military technology development believed by European commercial industry to be crucial to their own survival.

To believe, as in option (1), that the US will now buy an equitable amount (say up to 30 percent) of its technologically advanced armaments from Europe seems today perhaps even more implausable. The current state of US technology, the US political pressures, and the desire for flexibility of action seem to make the probability of making large numbers of US purchases from Europe difficult to anticipate. One can cite significant cases where each buys the products of the other, but I don't believe it can be done on the scale necessary to solve the problem of interdependency.

The concept of a two-way street based primarily on the exchange of technology, drawings and ideas has yet to be fully explored. Two aspects of such a two-way street need to be examined in detail. A two-way street of plans and technology can lead to cooperative programs to build the same equipment on both sides of the Atlantic. Conversely, it could lead to production of several different equipments, specialized to the interests of the producing nations,

but relying on the same cooperatively shared technology base.

Many people believe that standardization of hardware is the only hope of an Alliance husbanding its resources. I do not believe that at all. Competition is the basis of our economic system. Two tanks each in competition for the business of the Alliance may in fact be better than one. The key, I believe, is to offer the opportunity for cooperation across the Atlantic under equitable terms to the participants, and then to let the particular needs of the Alliance nations (timing, special technical requirements, etc.) determine whether they join in the endeavor or not.

I do not believe that nations can legislate or dictate standardization. I believe that when this has been attempted, it has led to inefficiency and waste instead of efficiency and economy. In fact, most knowledgeable economists believe our advanced standard of living is based upon avoidance of a regulated economy.

What we, as a nation, need to do is offer the opportunity for cooperation under terms of economic equity and then let nature take its course.

The cost of modern weapon development has become so expensive that large scale cooperation within Europe is already obliged. The proliferation which is abhorred today is the result of the situation that occurred 10 to 20 years ago when each nation could afford to develop weapons independently and then expect to sell to the world.

The US does not understand that this is no longer the case. The simple facts are that European nations will either cooperate within their own community or they will join their allies on the other side of the Atlantic. As long as neither side of the Atlantic works on the difficult problem of how to cooperate, the choice is obvious. Europe will be forced to work in its own closed economic community in order to achieve the economic fairness that it feels it needs.

ROLAND is a Ray of Hope

The proposal I have made for a two-way street of technology and plans can work. The short-range air defense system, Roland—adopted by the US from Europe—is an example to prove the point. Here, in exchange for equitable license fees, a European design has been adopted for manufacture entirely within the US by US industry. The US flexibility of action, labor base and technology have been maintained. Roland is a precedent that can work again and again. It can work either way across the ocean as long as cooperation is planned for early, before competitive national programs become entrenched.

Sometimes the US press has called the Roland program a failure. I believe it to be just opposite. Roland is about to become a truly outstanding success. For the very first time a missile made in Europe has been adopted for production in the US. Soon, from any NATO Roland launcher, a Roland missile of US or European manufacture can be fired. This is the first time that a complete assumption of another's design for full local manufacture has ever been accomplished. It could be a landmark for how to cooperate across the Atlantic.

If the managements of countries really wanted to do so, new programs of similar cooperation could be started. If national leaders really wanted, these new principles of cooperation could be widely tested. With either US or Europe serving as program manager, the nation(s) on the other side of the Atlantic could agree to participate to ensure that its interest were considered and to prepare to produce for itself. Yet, sadly, beyond Roland today, there are too few programs offering such cross-Atlantic cooperation.

Let me state, I believe the reason why Europe and the US are beginning to go their own ways rather than going together is that those in charge of nations are not working the economic problems hard enough. There are not people in Alliance capitals whose jobs and promotions depend on solving the economic problems of cooperation. No one at a high level of government in the US or within Europe is charged with putting traffic on the two-way street. No one will be fired if there isn't any traffic. Bureaucracy in any government does not support the "two-way street."

For example, in a Pentagon housing 25,000 people one would be hard pressed to find one tenth of 1 percent whose main task is to find a way to achieve NATO effectiveness in procurement of armaments. Those who have been so tasked are far away from the centers of preliminary design and decisionmaking authority.

Since Europe no longer is certain that the US is willing to make a "two-way street" work, the leaders in the US must take the initiative. The US must show that it now wishes to develop with European Allies an equitable basis for flow on a two-way street. The leaders of the United States must commit themselves to a basis of economic equity in dealing with Europe whether it be by buying arms reciprocally from Europe, by offering to solve in nonmilitary procurement ways the problem of commercial offset, by organizing the initial efforts at major cooperative

programs or, by encouraging occasional competitive developments—or as is most probable—by a combination of all of these means.

In like manner, the European nations must be prepared to follow suit, and be prepared to discuss how, when and under what terms transatlantic cooperation is possible.

Need for Permanent Organizations

To engage in a sustaining program for cooperation requires that a nation have the administrative capability to cooperatively plan with its allies. Permanent organizations are needed to think out problems, to formulate plans, and to make proposals for integrated Alliance arms development. Today neither the US nor the nations of Europe have an organizational entity which is committed to these tasks. To believe it will happen without organizational strength is to shut one's eyes to reality. Both the US and the European nations need "NATO thinking" people in powerful places, need them staffed adequately, and need them placed in the chain of program decision.

There are two obvious ways by which the bureaucracies of the Alliance can be made to respond to the decisions of their leaders to cooperate. It has always seemed to me peculiar that, when it comes to NATO matters, Presidents, Prime Ministers, Congressmen, Parliamentarians, Ministers of Defense, and Chiefs of Staff of nations can call for cooperation, mutual development and interdependence and then subordinates, almost to a man, seem to ignore the clear direction given.

The actions of the Alliance, I think you will agree, do not follow the words of its leaders. I do not believe this nonresponse to be malicious or intentional. I believe it to be the natural consequence of our contemporary bureaucracies not being set up to make the wishes of our leaders come about.

Virtually nothing happens in our modern bureaucratic process unless there exists power centers in the bureaucracy that have the responsibility to further the desired action. Contemporary experience shows that for ideas to succeed, there must be centers of power able to stop or to delay appropriations unless their special interests are catered to adequately. In the absence of a power center, even with high level urging, a bureaucracy will inevitably stall new initiatives.

One example from recent US Department of Defense history dramatically shows this principle to be true. For years and years, leaders in the DOD and in the Congress decried the low reliability of US military equipment. Much as "standardization" is today, "improved reliability" was then the popular cry. The more people preached the less the situation changed, simply because there were not a high level people whose job satisfaction derived from the demonstration of improved reliability" was then the popular cry. The more people reached the less the situation changed, simply because there were not at a high level people whose job reduced to compensate. So, for all the crying, nothing much happened to improve reliability. Then, Congress and DOD insisted on establishment of an independent testing agency that could stop production until tests verified reliability commitments. A man of ability and courage, Lt. Gen. Alfred D. Starbird, USA (Ret), was put in charge. He was given a staff of 25 people, and was required to report to the US Secretary of Defense the acceptability of test programs and test results. Programs were halted, tests were planned, and program go-aheads awaited test verification.

Almost overnight, the old bureaucracy accepted the new bureaucracy and conformed to make room for it. No longer did the lobbies of schedule and performance dominate but a coequal lobby ensured the interests of reliability. It worked then and it worked surprisingly easily. It could also work in the same way now to ensure national willingness to explore international cooperation.

The Situation in the United States

Although what I say applies to every nation, I will focus on the situation in the US. Though the US leaders want the DOD to consider NATO in its plans there is no one in power within DOD whose job uniquely is to make sure that what is wanted happens. No one in the US has a full time job to see that US designs are used by its NATO Allies or to see that allied designs are used by the US. Because no one stops a US program until commitments to NATO use are demonstrated, these interests are ignored.

The US Congress by Section 202 of its 1977 Military Appropriation has been very helpful. That Section requires that the Secretary of Defense report whenever he undertakes any procurement action which is not NATO standard or interoperable. However, honest people respond to their interests as they see them, and even rules like this do not help unless there is a bureaucratic way to enforce them.

The point that I wish to make to both my US and European friends is, simply, that without enfranchised bureaucratic representation, NATO research and development matters will not be substantially considered. Well intentioned forays by public officials will continue to be thwarted by the bureaucracies

that do not themselves enjoy gain by meeting NATO interests.

A Solution

My hope is that the Independent European Program Group (IEPG) can soon speak for the European nations of the Alliance in discussion of trans-Atlantic opportunities. The IEPG is a proper group to formulate the conditions under which Europe can see it advantageous to work with the US. However, as yet, the IEPG has not broadened its interests to include these discussions.

Although in the US, International Security Affairs and the Director of Defense Research and Engineering each have groups concerned with US interests in NATO, they would probably admit that they neither have the time, nor the people, to do the planning suggested. Nor do they have the power to enforce their plans were they to develop them.

Until the members of the Alliance set up in their own Ministries of Defense strong Starbird-like "Offices of NATO Affairs" no one should expect solving of the economics of the two-way street. Continued unwillingness of nations to set up such powerful offices can only mean that nations do not wish the loss of flexibility that comes with commitment to international NATO-wide cooperation.

Closing Thoughts

Let me offer one last suggestion on how to establish a meaningful two-way street. Were every nation, before embarking on a new armament development, to apply for what I call a "NATO Good Housekeeping Seal of Interoperability," we would begin somewhat correctly. Were we to start early to ensure that things work together today, replacements tomorrow might well be of one design done cooperatively. Today no nation is obliged to check with another on details of interoperability. Therefore, although we in NATO learn of new difficulties, we are obliged to wait for interoperability until "next time." To ensure interoperability, corrective bureaucratic procedure is required. There is now a proposition being examined by NATO nations to require the impartial outside interoperability review that I suggest. I hope that this initiative can gain national support. If it cannot, I will especially question the depth of the wishes of NATO nations for efficient use of Alliance resources.

We are now in a Verdun-like war of resources. The two-way street is a crucial but unthought-out concept that can help us in that battle. The two-way street is an economic problem of interdependency which we must find a way to solve. How to cooperate within the Alliance is a bureaucratic problem, not a technical problem. □

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From 1950 until accepting his present assignment, Dr. LaBerge was associated with the development of US space and missile programs for NASA and the US Armed Forces. He has served as an engineer in electronics, research and development, weapons systems, and management in positions of increasing responsibility. Dr. LaBerge received his doctorate in physics, 1950, from the University of Notre Dame where he received a BS (Physics) in 1947, and a BS (Naval Science) in 1944.

Dr. LaBerge, during World War II (from 1944), served as Executive Officer and then Commander of the YMS 165 that swept more than 200 mines, a number which is believed to exceed that of any ship of its class in the Pacific area.

US ROLAND—
A GIANT STEP TOWARD WEAPON COMMONALITY

by

Brigadier General Frank P. Ragano, US Army

Sharing Resources

Over the past few years, there have been numerous ill fated attempts to "standardize" United States equipment with that of our North Atlantic Treaty Organization (NATO) Allies. Most of these attempts have failed for a variety of reasons. However this has not reduced the US desire for true NATO equipment standardization and interchangeability. With increasing emphasis on commonality in recent years, international "interoperability" of weapons and interchangeability of components have been promoted. Joint development programs have been initiated. This emphasis has resulted in NATO governments giving undivided attention to weapons standardization through a sharing of the research, development, production, procurement, and deployment process.

Weapons commonality* among NATO Allies makes good sense. The resources of the US are not limitless. No longer can we afford the luxury of duplicating costly research and development efforts to produce a multitude of national weapons systems in defense of a common NATO threat. Sharing research and development efforts is one sure way to stretch limited NATO resources. Such sharing allows full counter to a joint threat. In addition, NATO partners enjoy cost savings inherent in increased production buys through the pooling of joint requirements. Finally significant savings can be gained through joint logistics efforts by reducing operating and support costs after the equipment is fielded.

Commonality fosters the sharing of resources, improves combat flexibility, and provides for quick reinforcement. In support of these desirable objectives, the US has embarked on its first serious attempt at transferring European technology of a complex air defense system to the US. This is the story of the US Roland. . . .

*The author perceives commonality in a very broad context and uses it in the context of both standardization and interchangeability.

The US ROLAND

The Roland story began in the early 1960's with the cancellation of a US development effort to field an all-weather short-range air defense system known as MAULER. Many of our NATO Allies were counting on the effort to produce a system that would counter a recognized low-altitude air defense threat. Upon cancellation of the MAULER program, the French and Germans entered into a joint development effort to produce a system to counter the recognized threat. Meanwhile, the US produced a clear weather system, known as CHAPARRAL, as an interim solution to the short-range requirements. In the late 1960's, following a number of US air defense studies, a growing need for an all-weather short-range system, was recognized.

In mid-1970 direction from the Office of the Secretary of Defense stressed increased cooperation with our Allies in the area of research and development. In addition, emphasis began to turn towards increased standardization of US equipment with the equipment of our European Allies. However, Department of Defense policy stressed the need to maintain a US production base for systems developed through coooperative efforts. Such a policy was clearly desirable to insure flexibility in foreign policy matters and to avoid the potential for compromise of our national goals.

In keeping with this policy the search for an all-weather short-range system shifted to the European scene where three candidate systems were in various stages of development: The British RAPIER, French CROTALE, and the Franco-German ROLAND. It was decided that these systems would be evaluated

to determine if they could satisfy the US need. The systems were evaluated and all were judged as capable of meeting the need.

The Proposal

In 1974 proposals were solicited from 21 sources. Four responded: Hughes Aircraft Company (ROLAND), Philco-Ford (All-Weather CHAPARRAL), Rockwell International (CROTALE), and United Aircraft (RAPIER/BLINDFIRE). In January 1975, a contract was awarded to Hughes Aircraft Company for the technology transfer of the Roland II weapon system to the US. The system was to be known as the US Roland.

The Roland is an all-weather short-range air defense weapons system that can locate, identify, and destroy low-level air attackers. Roland can acquire targets on the move. This weapons system can engage targets at all aspect angles at ranges in excess of 6 kilometers. Each system consists of a fire unit, missiles, and associated support equipment. While the US Roland system will be mounted principally on the M109 tracked vehicle, its modular design enables it to be employed on either wheeled or tracked vehicles as well as on trailers and at fixed ground locations.

The module includes a fully traversable turret with associated surveillance and track radars. The unit houses transmitters, radar displays, identification friend or foe (IFF), power generation and fire control equipment, and environmental control units. Each module is armed with 10 missiles: one on each of the two launcher arms, and four in each of the twin revolving magazines.

The Roland system was developed by Euromissile, a consortium comprised of Messerschmitt-Beolkow-Blohm Corporation, of Germany, and the Aerospatiale Corporation of France. The European program is under the direction of a joint French-German program office. Hughes Aircraft Company is the US Army's prime contractor for the US Roland—the Boeing Aerospace Company is the principal subcontractor. Both American companies are licensed by the Europeans for production of the system in the United States.

The philosophy in the development of Roland in the US was to strive for maximum standardization within the US Department of Defense. The standardization requirements for Defense Supply Management were the controlling criteria. These requirements specified that, to the highest degree practicable, items used throughout DOD would be standardized. In essence, these requirements maximize commonality between Roland hardware and other hardware items existing in, or to be introduced to, the US weapon inventory. Under this guidance, the contract was written to encourage selection of equivalent US parts, assemblies, materials, and finishes to facilitate the establishment of a US production base and permit maximum standardization in the Federal Supply System.

The Formal Program

The formal program to promote interchangeability between the US and European Roland systems resulted from Congressional interest to minimize "Americanization" of the system and to maximize NATO standardization. This guidance provided the impetus towards a high level of NATO standardization that resulted in extraordinary efforts to achieve NATO interchangeability.

At first there was some reluctance to delve fully into the area of "international interchangeability" (I^2). The initial decision was made by the US to achieve international interchangeability only at the missile round level. The European expected a greater degree of interchangeability. They continued to press to extend to the US those items which were already interchangeable between France and Germany. The interested parties made it clear that US acceptance of the European concept of interchangeability was a necessary condition for continued United States/European cooperation on the Roland program. By early 1976 a number of additional developments made a higher degree of interchangeability a more viable option for the US. These developments included the US decision to procure test equipment directly from Europe and the requirement for an extended joint test program using European hardware to maintain the US program schedule.

The Present Effort

In March 1976, the US Department of the Army agreed to ensure that Technology Transfer Fabrication and Test (TTF&T) hardware would be made interchangeable with European hardware to the maximum extent possible. At this same time the Army initiated a formal program to quantify the benefits and penalties of maintaining interchangeability during production.

At present, the United States is pursuing a course of action that could ultimately result in a total number of 558 field replaceable units (printed circuit boards, hydraulic components, etc.) that would be interchangeable with those of European manufacture.

One step taken to insure this capability: all electrical connectors used in the Roland fire unit are exact equivalents of the European connectors and in most cases were purchased directly from European manufacturers. The American producers are required to follow a strict "build to print", thereby insuring that components do not deviate in "form, fit and function."

The Difficulties

The road to standardization through international interchangeability has not been without rough spots as illustrated by the following examples.

Technology Transfer

First, at the onset of the program it was not clear that the transfer of technology would be a complicated process. As a result of that, as well as other complications, the contractor experienced a cost growth. Part of this cost growth was attributable to problems of transferring drawings. Both the contractor and the Government assumed that the Europeans had a drawing indenturing system equivalent to the US system. This proved to be an erroneous assumption. Each European subcontractor has its own system of numbering and annotating drawings. In many instances callouts on the drawings were references to a commercial catalog that had to be obtained and researched. Drawing changes were not always numbered sequentially and had to be researched to establish a change history. In addition, translation of technical information on the drawings presented problems.

Data and Documentation

Data problems resulted from the fact that many items of data that the contractor expected to receive as part of the European documentation were not furnished. Examples included: system employment procedures; survivability and electromagnetic compatibility analyses; human factors and training data; detailed fabrication and test specifications; production planning including tooling, test equipment, and test setups; and environmental, reliability, and availability test data. The gaps in system knowledge represented by these data shortages required that the American contractor initiate independent engineering analyses to produce the necessary specifications and documentation.

Competition for Full Scale Production

Since the prime contractor held the exclusive licensing agreement with Euromissile it was not possible to second source full scale production. The prime contractor was in a virtual sole source position, much to his advantage. It took a great deal of effort to renegotiate with Euromissile to allow second sourcing for competitive procurement in full scale production. Such an arrangement helps to insure adequate competition with the resultant savings and benefits.

Americanization

Early in the program, charges of "Americanizing" the system were launched at the Project Office. There was concern that funds were being expended on changes to the system to make it fit the fancy of US design engineers. These fears were nothing more than an enormous "soap bubble." Strict configuration control by the Project Office made it virtually impossible to "Americanize" the Roland system and a strict build-to-print (European) policy was enforced.

Finally, and with considerable dismay, it was found that the design was not totally stabilized. The results had significant impact on both drawing conversion and the fabrication process. The system was just entering European production when the US Army began the Technology Transfer Fabrication and Test program and the European contractors were continuing to process many, many changes. This was particularly true in the case of the track radar, when an almost complete set of new drawings was received after the technology transfer had begun.

These types of problems are representative of those faced in the technology transfer process. The problems were overcome and valuable experience was gained that will be helpful in future efforts of this type.

Commonality, A Reality

The reality of international interchangeability is being realized in the US Roland system—a reality brought about through intensive management efforts and an organization that recognizes the close international cooperation required to succeed in this type program.

Last fall (September, 1976) a restructured program was initiated that benefits from our earlier lessons. Communication improved among the various Government agencies, major contractors and suppliers. All parties have learned to compromise. Some of the normal development surveillance tasks have been recognized as unnecessary and have been eliminated. A new and comprehensive missile-firing test program has been established jointly with the French

and German Armies. The US will benefit from sharing firing ranges, using common data, and most importantly, from improved communication and cooperation with our Allies.

As we enter 1977, qualification testing has been completed on much of the missile portion of the US Roland program. Static firings of the propulsion unit are well under way, and qualification tests of the first complete missile will begin in June.

In midsummer Boeing will begin installation of the Hughes tracking and surveillance radars, as well as the electro-optical sights, into the first fire unit. Radars and sights for all four fire units will be finished by October.

Also in October 1977, the first fire unit and the first test missile will be delivered to the US Army. By Christmas of this same year 30 missiles will be ready for the joint test program.

The plan is to fire the first US Roland missile during winter, 1977-1978. The system is solidly engineered and will satisfy a driving requirement on the midintensity battlefield. Most of the confusion, misunderstanding and head butting are over. That is a tribute to the professionalism and dedication of defense and industry people on both sides of the Atlantic. They have led the way toward standardization, and have cut the path for others to follow. The US Roland will be an effective weapon system.

Like most bold innovation, NATO weapons standardization must go through a difficult learning process. But standardization is vital and should be supported and encouraged as it outgrows adolescence.

Observations

In summary there are a number of important lessons learned that should benefit future efforts in technology transfer from a foreign source.

First, it is imperative that US contractors acquire enough detailed data to understand the complexity and pitfalls inherent in the technical data transfer program. The contractors must insure that proposals adequately address the cost and schedule necessary to complete the transaction. Second, the degree of system design stability must be seriously assessed. Attempts to transfer a design that is not stabilized will result in cost growth and schedule slips. Next, the Program Management Office must be organized to allow continued close coordination with all (US and foreign) contractor and government personnel involved in the process.

Finally the Program Manager must make frequent personal visits to high-level government (DOD, Minister of Defense, etc.,) and contractor (President, Division Manager, etc.) personnel. The Program Manager must insure that the programmatic interface is properly established and functioning to allow the technology to be transferred in an efficient and timely manner.

Brigadier General Frank P. Ragano is Project Manager for the US Roland, an all-weather, short-range air defense system. A graduate of Duquesne University (BSE, 1950) with a MBA from Syracuse University, Brigadier General Ragano attended the Command and General Staff College and the US Army War College. He has served as a faculty member (in the Dept of Management) for both the Industrial College of the Armed Forces and the US Army War College. A seasoned combat Officer (Vietnam–four battle campaigns 1968-69), Brigadier General Ragano has had indepth project management experience. In 1972 he was assigned as Project Manager of the 2.75 Inch Rocket System. Later and immediately prior to his present US Roland assignment he became Project Manager of the CANNON Artillery Weapons System (CAWS) that included the highly successful Cannon Launched Guided Projectile (CLGP).

ROLAND, A Technology Transfer Program

by

John H. Richardson, Hughes Aircraft Company

To paraphase a recent song, "we can see more clearly now," after some 15 months of experience in transferring the Roland weapon system technology from Europe to the United States. The picture is somewhat different than that seen at the program's outset.

There were difficulties, ranging from licensing negotiations to parts classifications. My hope is that by sharing our experiences we may help those who will be involved in technology transfer programs in the future.

The ROLAND Technology Transfer

Clearly, the technology transfer has had far more ramifications than were contemplated by the contractors. While the learning cycle was painful at times in terms of program delays and cost growth, I am convinced that satisfactory solutions have been found. The benefits that will accrue to the US from cost and schedule savings appear to outweigh the difficulties encountered.

Team Concept

Let me outline the process through which Hughes teamed with The Boeing Company to become the US licensee to produce the Roland system. Hughes, because of its extensive background in air defense, was quite naturally interested in seeking solutions to the US Army's low-altitude defense mission. When the Army began to accelerate its low-altitude, forward-area, air defense (LOFAAD) efforts in 1970, activities at Hughes Aircraft began to accelerate.

System Selection

Analysis of the need for operational improvements to Short Range Air Defense (SHORAD), indicated that an all-weather capability was required for Western European operations because of the long periods of low visibility in that area. The apparent options were to make the current Chaparral an all-weather system, start a new US development, or deploy a European system.

After considering all the choices, including the French Crotale, the British Rapier, and the West German-Franco Roland possibilities, the determination was made by Hughes Aircraft that the Roland, *though considerably less mature than the other systems, was the most cost effective choice.*

Our concept was that the European system would be ready for true second source production in the US without any changes being made to the system. This proved to be a rather naive point of view since there had to be a few, though not many, changes made to meet US Army requirements.

The Team

About this time, Hughes and Boeing, both interested in the Roland license, determined that, working as a team, they could optimally produce the Roland. As a consequence, a team agreement was signed establishing the roles of the two companies in hardware production. Hughes was established as the prime contractor.

Euromissile selected the Hughes-Boeing team as its US licensee for the Roland in the Fall of 1972. A general agreement was signed in October 1972. This doc-

ument of agreement was the basis of the formal license granted by Euromissile in November 1973. The parties negotiating the license agreement attempted to achieve a balanced arrangement of the rights and obligations imposed on each. Obviously it is more difficult to negotiate for additional rights after an agreement has been reached.

Role of US Government

At this juncture the role of the US Government in license negotiations between American and foreign industrial firms deserves particular attention. In specific areas if assistance were given to the industrial participants, by the *US Government prior to the start of negotiations*, all would benefit. This assistance would be most beneficial if it were to include:

- Guidelines describing the royalty rates that might be acceptable for payment by the US Government under given circumstances.
- Special arrangements the US Government desires to have settled by the license agreement.
- Establishment of a set of fees and royalties considered reasonable by the US Government, OR
- Acceptance of reasonable fees and royalties agreed to by the US and foreign industrial entities.
- Detailed guidelines describing the conditions under which *the US Government may be free to sell, deliver, give away, or otherwise dispose of, the equipment to be manufactured under the agreement.*

Industrial representatives of the US then could request these rights early in the negotiations and identify or settle any areas of intergovernment conflict before final agreement is reached.

In the case of Roland, misunderstandings in the areas listed did arise. Some months after the contract award it became necessary for the three governments to negotiate a settlement. The negotiations resulted in a memorandum of agreement on August 19, 1975, and a memorandum of understanding on October 8, 1975. The industrial firms involved now are placing these arrangements in final form and negotiating an appropriate amendment to the license agreement. The license amendment then must be approved by the three governments, more than 15 months after the contract award.

Data Rights

Data rights provide another area that requires attention. If the US Government wishes to obtain rights in data beyond those normally provided, it would be well if industry were so advised. This advice should include the various arrangements that might be acceptable to the government so the data rights can be priced as necessary. For example, does industry need to obtain a price for total unlimited rights and/or a price for rights to transfer freely the data to any US industrial concern for US use only?

European Concerns

There is some concern in the European community that US industry might use European-generated data more efficiently than European industry and as a consequence the overseas industry wishes to limit as much as possible the number of US companies or individuals to whom the data may be delivered.

This desire of European industry to limit data distribution makes it *imperative for the US Department of Defense to notify the US industry if DOD will need to hire a support contractor* to supervise the performance of the US contractor so that arrangements can be made in the license agreement.

Second Sourcing

The US Government normally wants the right to be able to obtain a second source in production. The license must explicitly treat with this right and with the point in time when this right can be exercised. The licensor is understandably reluctant to have his data package, now converted for US production, released to other US companies without some consideration.

Licensing Approaches Available

On US Roland a license was entered into between US industry and European industry. An alternative would be for the US Department of Defense to negotiate for and procure a license directly from European industry. The military service involved could then conduct a competition within US industry for the system. This would require that the Department of Defense evaluate beforehand the foreign systems to determine which one to license and hence which one to compete. Such an evaluation would have to include an assessment of the price, reliability, reproducibility, mission suitability, and delivery schedules for each system, but without the involvement of US industry. At that stage only a very limited data

package would be available since the cost and time required to buy the data, translate it, and convert to US standards is excessive, especially on several systems. Having selected a system, a limited data package then would be put out for US bid and contractor selection. A major disadvantage to this alternative would be that the selected contractor could claim that any problems arising during the technology transfer process were the result of a deficient data package supplied by the US government. This, of course, would be in contrast to the current situation wherein we must solve such problems with our licensor.

Revision of Regulations and Procedures

The Department of Defense could perhaps facilitate the transfer of technology in future programs by revising certain regulations and procedures. For *example, before the issuance of a request for proposal, DOD should have a clear concept of what it is trying to accomplish in the transfer of technology.* Is the US attempting to save time and/or money? Are we moving down the "two-way street" of international standardization? Or both? The system being acquired will have evolved in a military, cultural, and social environment completely different from that of the US and must necessarily have significant differences in approach to end use, maintenance, logistics, and parts selection.

For desirable military, economic, and political reasons, the application of US military specifications and regulations applying to a US-developed system cannot reasonably be applied across the board to a system that was developed in a different way and which is already completed.

Engineering Changes

There has been considerable misunderstanding concerning the changes made by the US. To preserve interchangeability, the US Roland has not been Americanized. With the exception of two changes, it is being produced exactly to the European design. The two changes in the US version are substitution of higher rated igniter squids in the rocket motor of the missile to comply with our national safety standards and substitution of a higher power transmitter to increase the power output of the track radar for ECCM purposes. Those who contend that we have been making changes for "changes sake" are just plain wrong.

Performance Tests and Design Verification

Significant time and cost savings could be realized on certain performance tests and design verification if the US would accept the results of equivalent tests conducted in Europe. Ideally, only limited performance testing and environmental verifications tests should be conducted in the US to amplify on foreign testing and to verify that the technology was sufficiently transferred so that US-manufactured hardware performs as well as the European-made hardware.

Because of the extensive testing requirements laid down by DOD, the current technology transfer process falls somewhere between a true second source and a regular research, development, test, and evaluation program.

Standardization

Standardization, the type and degree, presents another dilemma. The degree of international standardization desired vis-a-vis the degree of national standardization among other US military weapon systems should be determined by the DOD. Currently, these two types of standardization pull in opposite directions at considerable expense in time, money, and effort.

Specifications and System Capabilities

An area of major concern is the possibility that DOD may expect more from a transferred foreign weapon system than that system is capable of providing. The Roland program is a case in point.

The SHORAD Request for Proposal (RFP) contained a system specification with considerable detailed application of normal US requirements. *United States industry responded by analyzing the licensed foreign weapon system and indicated the areas where it did and did not comply with specifications.* Because of the limited transfer of foreign technology at that particular time, US industry did not recognize that some of the requirements imposed on Roland were beyond the capability of the system without significant redesign.

This problem can be alleviated in future technology transfer programs if the government will submit the specifications to industry well in advance of the RFP, giving industry adequate time to make a detailed review with its European partners. The result would be a more complete and accurate response to the RFP.

Threat Assessment and System Requirements

Another factor affecting system requirements is threat assessment. In many cases the US and foreign view of the same threat is different. This variance

causes different requirements to be placed on the weapon system. Therefore, threat interpretations should be explored jointly by the US and foreign governments early in the procurement process.

Technical Data Transfer

The Europeans, for obvious reasons, are jealous of their technical data and would provide us only enough information to allow US industry to respond to the request for proposal. It is understandable that an American company not under contract would pay only a limited amount for such technical data compared to the value of the data package for which the foreign governments and industry have made a large investment.

It seems that the US should consider providing sufficient funds for technical data transfer as a type of phase zero contract to each competing contractor offering a foreign system.

Drawings

The Roland problem did not cease with contract award. On the contrary. The Hughes license agreement required delivery of all European drawings on microfilm cards within 30 days following contract award. *Actually, only a few drawings were on microfilm when the contract was let.* When one considers that the Roland fire unit and missile have 25,000 drawings plus 40,000 additional documents (compared to the original estimate of 25,000 drawings and 23,000 documents) comprising tooling data, manufacturing plans, catalog sheets, and specifications it is understandable that the mechanics to accumulate, photograph, document, and transport them consumed nearly 4 months.

In addition, the receipt process in the US, including customs clearance, unpacking, checking shipment contents, reproducing contents for translation, assigning Army part numbers to each drawing, cataloging, and distributing items to project engineering activities required an additional month.

Clearly, we must be more realistic in scheduling data transfer on future programs.

Translation

Translation was of such concern in terms of quantity and quality that Hughes considered preparing a large technical dictionary. In the end, a translation contractor located near the Hughes facilities in California, was selected, and with good fortune. Strict quality control was easy to implement, and as translation anomolies were quickly fed back to the contractor, a high quality translation product was achieved.

Parts Conversion

Conversion of electrical and mechanical parts from European to US parts is another major technology transfer issue. At present there are very limited European-to-US parts conversion lists and without those lists it is necessary to obtain an in-depth understanding of each part to assure proper conversion. With more than 17,000 different type parts on Roland, this effort required significant time and resources since the percentage of parts for which an equivalent US mil-standard item existed was less than we expected, 60 percent vs 90 percent. However, our estimate of total parts, 66,000, almost matched the actual number, 68,230.

Despite these problems, 99 percent of all parts conversions were made during the first 9 months of the program.

Lists of parts applicable for foreign military programs are being developed by NATO. When these lists are completed the parts conversion task will be simplified greatly, a genuine plus for future programs.

The parts problem does not apply to materials and processes. Almost all materials specified in European drawings are available in the US. Too, almost all manufacturing processes specified in Europe have been derived from US mil-standard processes. Thus, conversion from European to a corresponding US process was a direct task.

The original objective of the Roland program was to have all materials and parts produced in the US. In the initial phase of a technology transfer program wherein only a few systems are being fabricated, it is expensive to pay for this objective.

We recommend that in the future DOD allow limited quantities of parts to be procured in Europe where none exists in the US, or where high tooling costs are involved. *The suggestion is made that US equivalent parts be incorporated in the production phase where the tooling costs can be amortized over the production quantities.*

Drawing Conversion

Another thought. There does not exist among

European contractors a drawing convention standard such as we have in the US.

In the case of Roland there are 14 major contractors in Europe, each with its own drawing practices. The drawing transfer task required us to acquire most of the drafting room manuals from each European subcontractor to permit drawing conversion. In future programs, we recommend that European drafting room supervisors spend from 2 weeks to 1 month at the US contractor facilities to review the received drawings and documentation to enable a more rapid and efficient conversion to US drawing practices.

One other European deficiency is the lack of a complete indentured drawing list; that is, a drawing tree from top assembly down to each bit and piece. This lack required us to generate the indentured drawing list to understand the interrelationship among all of the drawings and documents received.

Here is the good news! Hughes successfully converted the drawings and released for manufacture 93 percent of the total technical data package 14 months into the program.

Engineering Change Management Controls

Another issue that should be addressed on future programs is the proper application of engineering change management controls by the cooperating governments. Change control must be applied uniformly on the European and US manufacturers. Lack of such control makes tracking of engineering changes in a timely manner by the respective industrial partners very difficult.

Thus, the US Government should negotiate with the cooperating foreign governments the overall engineering management control requirements. The detailed procedures for implementing these management controls should be left to the industrial partners for practical resolution.

Application of the Metric System

Finally, one element of the technology transfer task that was foreseen and understood was the fabrication of Roland in the metric system. The problems feared were less vexatious than expected and in fact quickly disappeared. Use of the metric system simply is no problem.

Observations

These are my thoughts. I have indicated those actions that I believe might be taken to improve future foreign technology transfer programs, and I have discussed the actions Hughes Aircraft took early to solve difficulties. The magnitude of the problems encountered is relatively modest compared to the large savings in money and time that will be realized when Roland becomes operational. This Army air defense capability is urgently needed. I am indeed happy that Hughes Aircraft is having a key role in providing the system. I do, however, regret having been a contributor to a cost growth problem for all of us. The hope is that by sharing experiences as we learn those who follow will be wiser.

Mr. John H. Richardson, Executive Vice President, Hughes Aircraft Company, has responsibility for the company's line operating organizations. Mr. Richardson has previously served as Assistant General Manager and Senior Vice President; Senior Vice President–Operations; and earlier, as Senior Vice President and Group Executive of the company's Aerospace Group. He is a member of the company's policy board and management executive committee. In World War II, Mr. Richardson served as a B-29 pilot with the US Air Force in the Pacific area. Mr. Richardson attended Princeton University, and has completed executive courses at UCLA and MIT as well as the American Management Association's Marketing course.

F-16—
NATO's Military and Economic Cornerstone

by

Brigadier General James A. Abrahamson, USAF

The F-16 is a military program to develop and produce an advanced, low-cost, multipurpose fighter for the United States Air Force and the Air Forces of four NATO Allies—Belgium, Denmark, The Netherlands and Norway. Of equal importance, the F-16 Program is an economic program designed to strengthen the NATO Alliance through coproduction. This high performance aircraft is to be delivered from three assembly lines, each located in a different country. A base of 4,000 US subcontractors and suppliers and 30 European coproducers are to be employed in the effort. These factors make the F-16 one of the most important efforts within NATO to achieve the benefits of standardization.

The Consortium

The F-16 consortium program is a partnership in the deepest sense of the word. The importance of the objectives and the complex dynamics of the program can be seen from a brief examination of the program history, the F-16 itself, the coproduction effort and the depth and significance of F-16 standardization.

The F-16 consortium program was born on both sides of the Atlantic. In the United States, a prototype demonstration program was underway to evaluate the application of advanced technology to a new generation of lightweight, low cost, highly-maneuverable fighter aircraft. Two aircraft companies, General Dynamics (the YF-16 aircraft) and Northrop Aircraft (the YF-17 aircraft), were selected to design and build two lightweight fighter (LWF) prototypes. When the USAF determined that such a concept was feasible and functional, the LWF Prototype Program was accelerated and competitive flyoff conducted. Based on this flyoff and mission and cost considerations, the US decided to develop and produce the F-16. Plans to implement a "full-scale" development program were initiated.

At the time the USAF was pursuing its lightweight fighter prototype efforts, the Belgain, Danish, Netherlands and Norwegian Governments were evaluating the need to modernize their tactical air forces by replacing aircraft such as the F-100 and F-104 which were rapidly approaching obsolescence. Far-sighted individuals in these European nations concluded that the most practical method of approaching the problem was to integrate activities such that a common replacement aircraft, meeting common requirements, could be procured for the respective Air Forces.

A four nation consortium was constructed to pursue selection of a replacement aircraft on a multinational basis. Considerations of economics, balance of payments, technology transfer, and industrial stability were of major concern to the European nations. In addition to the operational aspects of a replacement aircraft, it was decided that selection would also be based on a requirement that the aircraft would be coproduced within the consortium nations to offset aircraft and support equipment investment.

The European Governments selected three candidate aircraft for evaluation: the French F-1E Super-Mirage, the Swedish AJ-37 Viggen, and the winner of the US lightweight fighter competition, the YF-16. After an arduous series of evaluations and negotiations, the European Governments selected the F-16. This selection was made because the F-16 provided a combination of demonstrated capability and significant advancement in technology and performance while providing a system that was not

overly complex. The F-16 offered the potential for lower cost, and improved reliability and maintenance capability. The selection was made on the basis of the commitment that coproduction would take place in each of the four countries such that at least 58 percent of the acquisition cost of a 348 European aircraft program would be offset.

Negotiations for the F-16 Multinational Fighter Program (MNFP) were concluded on 10 June 1975 by the signing of a five-nation Memorandum of Understanding that provides the basis for the current F-16 five-country development program. The participants were the United States, Belgium, Denmark, Norway, and the Netherlands.

In addition to numerous operational features and technological advancements, the F-16 provides innovative and unique economic features that deserve attention.

The F-16 program is a joint business effort to produce the F-16 in the United States and in Europe. As a result management of the program is complex. The ultimate goal of the program is to place certain F-16 production business in Europe to offset 100 percent of the cost of the Europeans' initial buy of 348 aircraft. The 100 percent offset is to be completed with the sale of 2000 aircraft. This buy represents about $2-3 billion, measured in 1975 dollars. The offset goal is to be achieved in phases based upon the total number of aircraft produced, e.g., 58 percent of the Europeans' outlay is to be offset during the production of the first 998 F-16 aircraft (650 US, 348 European) and the target of 100 percent offset should occur when 2,000 aircraft have been produced.

The coproduction of the F-16 consists of the fabrication and assembly of major structual components by both the US and European industries, interchange of these components among the industries, and assembly of the F-16 in the United States and at two locations in Europe. European industrial production will result in 348 aircraft rolling off the assembly lines in Belgium and the Netherlands. Norway and Denmark will be involved primarily with producing avionics and equipment subsystems. Industries in Europe will also support deliveries of the F-16 from the production line at Fort Worth, Texas.

Aircraft and engines manufactured in Europe will be made to US engineering specifications. The US drawings will be provided to the coproducing companies. In most cases, these drawings will be converted to metric and translated to the national language. The drawings will then be used to generate the "factory paper" of the European participants, i.e., shop instructions, blue prints, process sheets, etc. Inspection and acceptance will be to the original US drawings and specifications—in the English language and in nonmetric measurement. More than thirty European companies will be involved in this coproduction program. Three experienced aircraft companies (Fokker, Fairey and Sabca) will manufacture airframe components, and assemble and deliver the F-16 to the Air Forces of the European participating Governments. The other twenty-seven plus companies in Europe will be involved with avionics items and equipment subsystems. Four countries are participating in fabrication and assembly of the engine. Forty such items are being coproduced with some companies being involved with more than one item. The list reads like a "Who's Who in European Business." All are respected firms.

The coproduction program is not without danger. The US Air Force program management must be sensitive to the complexities of doing business in Europe. The amount and timing of holidays, the use of overtime or multishift operations, risk-taking philosophy and European manufacturing span times are some of the areas that might affect the integrity of schedules. For example, US leadtime for F-16 manufacture and delivery is 24 months, while it is, normally, 36 months in Europe. Certain management initiatives will be required on the part of the US over the next 6 years, if the entire program is to be kept on schedule. The task is not easy. The potential pitfalls and complications of delivering high performance aircraft from three assembly lines, each located in a different country, using a base of 4,000 US subcontractors and suppliers and more than thirty coproducers in Europe, is mind-boggling. Chart A illustrates some program benefits each of which each carry a corollary complexity.

Among the most difficult of the challenges is configuration management. Problems from "user" inputs have been dealt with in past programs, but the impact of changes on the five-nation coproduction is unusually severe. The related fields of production control, international contracting and financing play an important role in configuration decisions. A Multinational Configuration Control Board decides on the acceptability of changes proposed by the contractors and using Air Forces. The Board is comprised of representatives of the five-nations.

The benefits of coproduction, enjoyed on both sides of the Atlantic, constitute the overriding consideration. The increase in jobs in the greater Fort Worth Texas area, where the F-16 is produced by General Dynamics, is significant. A little less obvious is the great number of jobs being created throughout the United States at the subcontractor level. It is con-

CHART A

Program Benefit	Corollary Complexity
Transfer of technology in areas such as landing gear, engine and assembly line techniques	Requires relocation of experienced personnel from five countries with subsequent dilution of corporate capabilities
More jobs and business through "Cascade" effect of increased production	Careful planning and more lead-time are required because of differences in socio-economic systems (i.e., overtime, shifts, wages)
Five countries share cost of development	Exchange rates, currency commonality, and "fair-shares" must be established
Interchangeability of parts resulting in *inventory reduction* and increased supportability, operability, maintenance capability	Increased emphasis on quality control and data transfer, requirements, and procedures
Configuration inputs from all countries get into development early	Changes result in potential cost and time loss

servatively estimated that 40,000 Americans will be employed in the manufacture of the F-16 when full production is achieved. In Europe, about 6,000 people will owe their livelihood to the F-16 Multinational Fighter Program.

The technical transfer aspects of the program are almost as important as the economic benefits. United States aerospace companies are working closely with various and diverse European industries. In some cases, the relation is one of peers working together to produce a common item. In other cases, the US partner in coproduction has taken the role of mentor and is developing a capability within the European partner that did not previously exist. From a people-to-people standpoint, the F-16 Multinational Fighter Program is a tremendous success and may be a model for future international ventures. Each day brings a closer mutual understanding of viewpoints among the people of the five participating nations. Americans have been placed in Europe to work closely with Belgian, Danish, Dutch and Norwegian industrial or military people on a daily basis. Europeans have been sent to the United States to assist in program management.

The following is a summation of some of the key lessons learned in the F-16 coproduction program. These lessons include considerations of currency exchange, the Buy American Act and the cultural differences of the various countries.

Currency Exchange

The coproduction effort flowing from the F-16 Multinational Fighter Program has grown to encompass more than 30 European companies and in excess of 50 subcontractors. The multifaceted transactions among these European companies, the US subcontractors, and the F-16 primary airframe and engine contractors, require continuous currency transactions. The participating governments of Norway, Denmark, Belgium, the Netherlands and United States agreed, in the Government to Government Memorandum of Understanding signed in June 1975, to the principle that companies participating in the program should be insulated from the inherent risks of open marked currency fluctuations. Thus, all F-16 Multinational Fighter Program contracts have been issued using the fixed exchange rates that were established by the five participating countries.

This unique arrangement created a complex problem of implementation for the program office. The resulting procedures, which are still in the process of being finalized, require the combined efforts and talents of the Department of the Treasury, Department of State, Headquarters, United States Air Force, Headquarters Air Force Systems Command, Air Force Accounting and Finance Center, Air Force Contract Management Division and the international banking community.

The resultant procedures will utilize an Air Force Accounting and Finance Center controlled currency clearing house which will be associated with resident banks in the participating countries.

Currency forecasts will be required from all participating subcontractors to permit allocation of the appropriate mix of funds to the currency clearing house. All contractors then will be required to use the currency clearing house for all transactions requiring currency exchange.

Buy American Act

The Buy American Act restricts Department of Defense procurement of certain non-US products. Where such procurements are necessary, the procur-

ing agency must fully substantiate the requirement on the basis of cost, availability or related factors that justify procurement of a non-US item. Such procurements are normally handled on a case-by-case basis. Depending on the nature of the procurement, authorization to waive provisions of the Buy American Act are granted at the local level for low value items or at the Service Headquarters or DOD level for large procurements.

Coproduction aspects of the F-16 program, requiring that European industry produce hardware items equivalent in value to 10 percent of the procurement value of the USAF acquisition of 650 aircraft, required issuance of an exemption to the Buy American Act. This exemption is reaccomplished annually and applies to those items procured from European industry that count toward achievement of the US offset commitment. The exemption was issued by Headquarters, United States Air Force, Deputy Chief of Staff, Systems and Logistics (AF/LG) with approval of the Office of the Secretary of Defense, Defense Security Assistance Agency (OSD/DSAA).

Exemption of this nature will be required for all cooperative development/acquisition programs through which the Department of Defense obtains military hardware manufactured outside the US.

Cultural Differences

Coproduction planning accomplished by US prime contractors (General Dynamics and Pratt and Whitney Aircraft) was done on the basis of assumptions that did not anticipate cultural differences between US and European industry. In fact, there is a substantial difference between ways of doing business in the US and in Europe.

- **European Wages**. Based on a more socialistic society, European wages include higher amounts for health, social security, retirement and other fringe benefits than do US wages.

- **European Personnel Income Taxes**. European personnel income taxes are substantially higher than US personal income taxes. These European taxes are based on a more progressive rate structure that results in strict adherence to the basic work week. Much of European industry prohibits the use of overtime, limits operations to a 5-day work week, and works only one shift per day to avoid forcing employees into high income tax brackets.

- **Vacation Privileges**. European society is more conscious of vacation privileges. Where US vacation periods are normally taken at random and there is little or no effect on production rates, European vacations are more structured; industry often shuts down for specific periods of time, and production may come to a complete halt for those periods.

- **Production Rates**. The US industry is oriented toward high rates of production and with little regard for economic or work force stability. European industry is very conscious of these factors and works toward achieving long term stability in both the work force and in production rates, profit, and capital investment.

- **Schedules**. Schedules are directly affected by wages, taxes, worker privileges and production rates. Where an F-16 aircraft can be produced in the US in 24 months, an F-16 aircraft produced in Europe may take as many as 36 months to produce and will be more expensive.

- **Capital**. European industry is under capitalized in comparison with US industry. There is also a substantial portion of European industry which is partially or wholly government owned. As a result, there is a cash-flow problem that results in the use of advance funding and/or application of partial payments at the 90 or 100 percent level rather than at the 80 percent level which is typical in US contracts.

- **Accounting Practices and Other Procedures**. There are also differences in accounting practices, audit procedures, solicitation and bidding procedures, procurement regulations and procedures, and contractual procedures and minor differences in quality control standards and procedures. European industry also uses the metric system of weights and measurements while US industry, though slowly changing, is still standardized on the inch/pound system.

All of the factors stated have influenced the way in which F-16 coproduction will be accomplished in Europe and the manner in which program agreements and contracts have been negotiated and implemented.

In all aspects where differences have been encountered the governments and/or the contractors have been required to negotiate a solution. The US cannot impose its procedures or standards on European industry. The result is normally a compromise in which both sides must alter their normal approach or treatment to some degree.

Multinational agreements have been negotiated concerning application of the Armed Services Procurement Regulations (ASPR), cost accounting standards, quality assurance standards, contractual and technical audit procedures, exemption of national taxes and duties, application of the specialty metals clause, liability for patent infringements, liability for ground/flight damage, currency exchange, economic price adjustment, configuration management, and a multitude of other F-16 program aspects of multinational concern.

Terms and conditions of contracts between the USAF and US industry must be passed on to European industry. Negotiation of these terms and conditions was accomplished, but with considerable difficulty. In many instances these negotiations were successfully completed only after reaching agreement at the Government-to-Government level on general principles or policy.

A significant difference, related to but apart from the above, concerns international business experience. Most European firms have been involved in international business and production for many years. United States firms have been involved to a significantly lesser degree and, at that, have dealt with foreign subsidiaries of the parent US corporation or have worked only under a license arrangement with a foreign firm who would manufacture a US developed product for use by their Government or for sale in the international market. The F-16 prime and subcontractors had little experience in international industrial cooperation and coproduction. Initial contracts with European industry suffered owing to this lack of experience and the "not invented here" approach taken in dealing with European industry leaders. United States Government agencies suffered from this same lack of international experience—the lack of sensitivity to European concerns and issues, and a tendency to deal with the European Air Forces/Governments on the basis that the US way was the only way. Change in this attitude, which is not yet complete, has been a difficult process.

A large number of European business people have spent considerable periods of time in American factories receiving technical training. At the same time, these persons learned about the American way of life. United States personnel assigned to Europe are gaining an appreciation of the quality of life in Europe. The goal of "bringing people together" is being achieved. Every member of the team must go about daily tasks considering the "big picture" and not any single, national point of view.

Thus, we have dealt with the military and economic complexities of the F-16 Multinational Program—a complex program that demonstrates the necessity for partnership management by what may be, perhaps, unexampled cooperation and mutual consultation. The complexities of this pioneering management process often seem staggering but the experience to date has been positive. Progress has been keen. Beyond the routine debate that often characterized NATO common efforts in the past, the F-16 multinational team is hammering out vital decisions, and implementing far-reaching actions for the benefit of all.

At the root of this progress has been a strong, unprecedented spirit of cooperation and trust. Curiously, the bond has been strengthened by common constraints among the participating nations. Each of the five nations has been strongly motivated by the *need* to modernize its tactical air force by the most economical means—and get the most for its money. The F-16 fulfills this need. Each of the countries has been keenly interested in standardizing those weapons systems that are frequently in concurrent use in neighboring Allied Forces. Here the F-16 is a giant step forward. All nations, in the face of shrinking defense budgets, want to recoup expenditures by sharing in the benefits that accrue from sales. The F-16 provides such a solution. Although not a panacea to the problems of procuring economically suitable and credible military hardware, the F-16 carries with it an unusually large and varied number of attributes. These attributes provide high motivation to participating nations—incentives to work hard at solving the inherent management complexities.

The purely military benefits of NATO standardization and tactical modernization are so evident and necessary that the question of objective does not arise. The fundamental decision forum shifts to the economic and political constraints.

As five sovereign nations go about the detailed analysis of tactical doctrines, mission usage, and resultant F-16 equipment selection to meet particular requirements, it might be expected that different equipage and configuration will occur. This has been true in the past, when economic and political factors were applied to potential common programs. This is not the case with the F-16. The five nations began with twenty-one country-by-country peculiar F-16 configuration requirements. These requirements have devolved to five minor items. Because of early economic and political harmonization, mutual common interests rather than differences are driving the program. In addition to the production economics and operating advantages of a universal F-16, the benefit in having similar support equipment, training equipment, and maintenance and training philosophy can

be applied. These benefits yield a broader market for support equipment and allows the quantity increase so necessary for economical coproduction. Further, a pooling of spares and joint usage of depots provides large potential cost savings over the program lifetime.

The ability to operate during wartime situations using the bases, support equipment, armament, maintenance teams, and communications of allies is a tremendous benefit of commonality. Proposed war plans of the five nations are beginning to reflect the increased flexibility that equipment commonality provides.

Just as the American colonies, fortified by a common European heritage, banded together to create an entity stronger than the sum of the parts, the F-16 provides NATO with a dynamic economic, political and military program–a program that provides tangible benefits to all participants in both peace and war. In essence, the F-16 can be described as a major cornerstone expected to put teeth in the NATO Alliance and provide a better defense for all. This then is the real value of the F-16.

The F-16 Air Combat Fighter is a single-engine, lightweight, high performance aircraft. Powered by a 25,000 pound thrust (11,364 kilograms) class afterburning turbofan engine, this highly maneuverable fighter excels in air-to-air combat and delivery of air-to-surface weapons.

F-16 First Leap

The F-16 is 48 feet (14.6 meters) long, 16 feet (4.9 meters) high, weighs approximately 22,800 pounds (10,350 kilograms) at take-off, has a combat radius of over 500 miles (805 kilometers) and is capable of exceeding Mach 2 (twice the speed of sound).

The F-16 will complement the more sophisticated F-15 in the air superiority role, and supplement the F-4, F-111, and A-10 in the air-to-surface role.

Brigadier General James A. Abrahamson is the USAF Program Manager for the F-16 Air Combat Fighter Program, Wright-Patterson AFB, Ohio. He is responsible for directing the five-country consortium effort to develop and produce the F-16 fighter aircraft.

An MIT graduate, Brigadier General Abrahamson became a test pilot in 1967 and was selected as a astronaut for the USAF Manned Orbiting Laboratory program. He has served on the National Aeronautics and Space Council staff, Executive Office of the President; he has managed the USAF "Maverick" missile program; was the Commander of the 4950th Test Wing, WPAFB; and was Inspector General, Air Force Systems Command.

A command pilot with over 3,000 flying hours in conventional and jet fighters, Brigadier General Abrahamson has flown 49 combat missions.

Commonality—Or, What's in a Word?

by

Colonel D. W. Waddell, USAF

The Defense industry, and the military, in particular, is noted for the generation and use of acronyms and buzz words. In fact, you are a nobody if you do not have an acronym or buzz word of your own. The Office of the Director, Defense Research and Engineering (ODDR&E) is not an exception.

The "in" word now is COMMONALITY. Commonality is a handy word that can be used in mixed company as well as among the enlightened groups charged with giving it meaning. "What does it mean"?, you may ask. That's a fair question, but "Who wants to know"?

Webster defines commonality as "possession with another, of a certain attribute." Doesn't sound very military, does it? The definition certainly is not menacing. Look again, though. The very generality of this word is its claim to fame—it has flexibility (another buzz word!) and may come out as

- **Commonality**—A quality which applies to materiel or systems possessing like and interchangeable characteristics enabling each to be utilized or operated and maintained by personnel trained on the others without additional specialized training; and/or having interchangeable repair parts and/or components; and applying to consumable items interchangeably equivalent without adjustment.[1,2]

- **Compatibility**—Capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference. (NATO, CENTO, IADB)[2]

- **Harmonization**—1: the quality or state of being in harmony 2: an act or instance of producing harmony; a piece of harmonized music.[3] Process of merging similar requirements and/or developments into a common effort of mutual benefit.*

*Author's adaptation of definition and concept for use.

"Harmonization" refers to the process, or results, of adjusting differences or inconsistencies in the qualitative basic military requirements of the U.S. and its Allies. It implies that significant features will be brought into line so as to make possible substantial gains in terms of the overall objectives of cooperation (e.g., enhanced utilization of resources, standardization and compatibility of equipments). It implies especially that comparatively minor differences in "requirements" should not be permitted to serve as a basis for the support of slightly different duplicative programs and projects.[4]

- **Interchangeability**—A condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves or of adjoining items, except for adjustment, and without selection for fit and performance. (DOD, NATO, CENTO, IADB) The quality or state of being interchangeable.[3]

- **Interoperability**—The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.[1,2]

- **Standardization**—The process by which member nations achieve the closest practicable cooperation among forces, the most efficient use of research, development, and production resources; and agree to adopt on the broadest possible basis, the use of: (1) common or compatible operational, administrative, and logistic procedures; (2) common or compatible technical procedures and criteria; (3) common, compatible, or interchangeable supplies, components, weapons, or equipment; and (4) common or compatible tactical doctrine with corresponding organizational compatibility.[1,2]

Now that we have breached the line between what

you know and what you didn't care enough to ask (about), you might as well string along, because there is more. Here is your chance to find out how the term *commonality* came about, what we have done about it lately, and what we plan to do about it later. There will be a few words on how commonality fits in with our European friends, too. So in the order . . .

Why do we have it?

How did it come about?

we explain commonality.

Prior to 1965, Secretary of Defense McNamara was asking questions like "Why don't you borrow so and so from the (Army/Navy/Air Force)"? The answers ran something like—"But Sir, their "whatsit" has a "gidget" on it and won't fit our "gismo." In 1965 the Office of the Secretary of Defense decreed establishment of the Defense Standardization Program. The objective was to reduce proliferation.

The issue came to a head shortly thereafter with the infamous 20mm incident that occurred in Southeast Asia.

In this case, the Navy had docks full of 20mm high explosive incendiary ammunition and the US Air Force had none—or thereabouts. Even though the Air Force and Navy were "friendlies" in that little scrape and would have shared, ocean going bullets wouldn't work in other folk's guns. After numerous expressions such as . . . expletives deleted . . . , a special task force was formed to work out the problem. In 1969 the Air Munition Requirements and Development Committee (AMRAD) set up shop for a 1-year crash effort to make sure such an episode would not happen again. The committee members did their work so well soon other areas within air munition were found to have similar problems. The committee then was extended for 1 year. By the end of the 2d year a name had been made for AMRAD and the committee was given a charter to "keep up the good work." (Now everyone does not agree with that last phrase—especially the Service that gets a program cut when there is an overlap or redundancy. We like to think it's good for the Department of Defense if we get more guns and ammunition and still have money to feed the troops. Read the summary on AMRAD at the conclusion of this article and decide for yourself.)

Through mutual interest, our European Allies are on the bandwagon with NATO Standardization Groups that look at multicountry problems. The NATO Standardization Groups produce STANAGS, or Standardization Agreements, that define the ground rules for commonality in a variety of weapons/systems. Effecting the rules is another ballgame, but we are all playing now.

The influence of the US Congress is worth mentioning for those of you who do not read the Washington newspapers each day. In the process of doling out dollars, the Congress makes it clear that more is wanted for less—and defense is the active model for gaming. Senator Nunn, (D-GA) has a special interest in our NATO relations and has sponsored legislation* that emphasizes standardization.

What is the Problem? — What Are We Doing About It?

All of you who have been around a while are aware of the numerous types and varieties of US weapons that came about through the largesse of the "guns and butter" era of Vietnam. However, paying the piper is not a fun game anymore. We have found that certain handy gadgets are costly to maintain and to operate**—not to mention, expensive to replace.

Our job is to get new weapons and weapons systems designed, developed, and produced. Unfortunately, it is not easily done. Look at the dollar-pie of any recent year and you will see that after Operations and Maintenance (O&M) and Procurement are served, Research and Development (R&D) gets a mighty small slice. Divvying that slice among the Services is no small chore as requirements dictate allocation.

Most of you recognize that many development/procurement decisions are based on nonmilitary interests. Further, things such as maintaining a strong technological base and a reliable industrial base may work to aid or complicate employment patterns around the country. These factors—and others—must be taken into account. If not resolved in the Pentagon, the issues will come up on Capitol Hill.

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*The Nunn Amendment to P.L. 93-365 (Defense Appropriation Act of FY 75) requires annual reports on military and economic costs of nonstandardization of NATO weapons. The Culver-Nunn Amendment, P.L. 94-106 (Defense Appropriation Act of FY 76), requires listing of procurement actions on new major systems not in compliance with the "sense of Congress" to standardize NATO weapons. The amendment of P.L. 94-361 (Defense Appropriation Act of FY 77) established NATO standardization as "policy of the United States."

**Logistic rule-of-thumb: Support costs over the life of the system will be approximately equal to the weapons acquisition costs.

What Have We Done Lately?

Some early efforts for commonality were band-aid remedies. Other efforts had lasting effects. Among the latter are the F-4 and A-7 aircraft used by the Navy/Marines and the Air Force. Too, air-scatterable land mines and laser-guided munitions (LGM) are areas where consolidation of requirements and development efforts led to significant savings. Several *ad hoc* groups, not all as productive as the LGM group, have come and gone. Among the hurdles and pitfalls are specification differences and interface problems. Often, the tail is wagging the dog.

A current example of where good intentions go awry is the case of the Light Weight Fighter (LWF). This airplane was to have been selected from Air Force prototypes of the F-16 and F-17. By military and congressional design, Navy was to follow suit and every effort would be made to get NATO to adopt the same airplane. The game plan worked great for the first half—Air Force selected the F-16 and NATO bought-in in a big way. Then, the Navy chose the F-18—a variation of the F-17. While the Navy selection was justified on the basis of differing military needs, nonmilitary interests carried a lot of weight. (Ever tried to juggle three balls, and two rings?) Now we have two aircraft, two engines, two avionics packages, two stores management systems—two everything! Efforts toward commonality of systems, here at least, are frustrated by the fact that the Air Force is ahead in development and with NATO commitments. The designs are "locked in."

Since it seems that "the effect on NATO" is arising more often these days, let's take a brief look at how the North Atlantic Treaty Organization fits into the juggling act.

NATO

Although the NATO R&D dollars are approximately equal to those of the Warsaw Pact, NATO has excessive duplication. In fact, senior NATO Commanders have estimated that proliferation and the corresponding lack of arms standardization depresses the effectiveness of Allied forces in Europe. In 1974, for example, there were:

- 4 different main battle tanks
- 31 different antitank weapons
- 100 different types of ships, destroyer size or larger, equipped with
- 36 different types of radar
- 8 different types of surface-to-air missile systems
- 40 different types of guns of 30mm or larger caliber
- 11 different types of combat aircraft in Second Allied Tactical Air Force.

Why does this condition exist? The answers are interesting because they expand on the situation in the United States. First of all, there are "national domestic policies" influenced by such things as industrial pressures and tradition. Second, the NATO countries are generally unable to:

- harmonize the different national military requirements;
- obtain efficient multinational program organization and management;
- depend upon each other for critical development; or
- insure achievement of the legitimate economies.

The costs of the "unables" generally fall into two categories—economic and military effectiveness. A glance at the economics reveals that in FY 75, NATO had a credit balance of roughly $1 billion in research and development duplication. A "reasonable estimate" of each year's nonstandard equipment procurement is 10 percent of the total, or approximately $2 billion per year.

As for military effectiveness, the payoff is not as tangible, but military leaders strongly agree that lack of standardization significantly reduces capability. A general effect is inflexibility—in some cases, forces would not be able to respond to a major change in mission. Some effects are more specific; e.g., aviation fuel has long been standard, but the means, and equipment, for rapid refueling are not. Aircraft munitions, armaments and maintenance power units are different in most air forces.

Among the seven major European nations of NATO, there are seven different combat aircraft, six different recoilless rifles, four different types of wire-guided and antitank weapons, and three different types each of mortars, rifles, and machine guns. Each of the seven national units in the NATO force must maintain its own logistics personnel and establish its

own logistic support. Expensive duplication would be a descriptive understatement, and the situation is not aided by the nonstandard communications systems that exist.

What Are We Doing About It?

There are opportunities galore, to do something about the NATO situation, but support is needed from each and every nation. A big step was taken when last year's NATO ministers' guidance called for greater Alliance cooperation. The US Government has both long- and short-term designs for coping with the situation. The premise for the short run is that achievement of interoperability and compatibility between existing national weapons systems is the most that may be feasible now. Complete standardization will make economic sense only in the case of new weapons systems, for example, the F-16 and the Roland. In the current year, DOD has identified specific areas for emphasis; that is, equipment standardization, including common families of ammunition, military exercises, protected command facilities, relocation of forces, interoperability and consolidation of communications (including Airborne Warning and Control Systems), antitank training, etc.

Initial focus for the long term will be on the halfway house of interoperability, and eventually the focus will move toward competitive prototypes. Along the way, we will work to establish common selection procedures and production of standardized equipment on both sides of the Atlantic. Other necessary steps include sharing of production rights to selected systems and the freedom to use standardized equipment in foreign assistance programs.

In sum, the military, economic and political advantages are well worth the dependence involved. The Department of Defense is committed to a maximum effort to harmonize US and NATO weapons requirements. Secretary Rumsfeld set the tone with his statement, "This is the time to reach out—not back,"[5]

Where Do We Go from Here?

In efforts to the present, some lessons have been learned and some new problems have been identified. Generally speaking, there is now a wider acceptance of the need to standardize weapons systems among the Services and in NATO—or at least a recognition of the need to make these systems interchangeable to the greatest degree possible. (We are NOT pursuing the impractical goal of complete, across-the-board uniformity.)

Given the multiplicity of economic, political and technical factors, standardization in NATO really means greater interdependence by all partners. (That is a subtle way of saying there will be new constraints on US efforts.) New transatlantic programs will likely involve licensed production. In some cases it will no doubt be cost effective for our Allies to buy complete systems and/or components from the US. If this be true, we must be prepared—and willing—to reciprocate by adopting European armaments when these armaments meet US requirements and are cost effective. In other words, it must be a two-way street.

For this approach to be successful, broad-based involvement and support will be required of our own three Services. That, in itself, is no small challenge since the US has its share of concerns and problems that must be resolved to permit efficient allocation of effort and resources.

The central figures in the resolutions will be the Program Managers within the Services—not only those assigned to joint, or multiservice programs. *All* of you will have to deal with these concerns to some degree, at one time or another. How you deal with them will determine whether the concerns are valid or just old wives' tales. Here are a few examples, with comments . . .

1. COMPETITION. Competition gives R&D contractors incentive to design more efficient products and provide government a choice of weapon characteristics, hopefully over a range of prices.

COMMENT—The concept is fine but, often, we hang onto "options" until they become "choices" that are difficult to turn off with out severe industrial and/or political penalties. Consequently, duplicative systems may be deployed.

KEY—Select what is to you THE best solution as early as possible in the development cycle. Do not postpone nor delay this action.

2. ECONOMY OF SCALE. Economy of scale applies in the production phase (where direct cost and allocation of overhead determine unit cost) and in the testing procedures, e.g., testing 10 of 1000 items vs 10 of 100. Economy of scale leads to the general statement that "more is cheaper."

COMMENT—The Economy of Scale effect is true in automobiles, pocket calculators, etc., *but* a typical major weapon system quantity is in the hundreds. "Minor" items of high volume (e.g., ammunition) may have payoff, but be careful of robbing Peter to pay Paul. With all work at one

company or plant, other firms may leave industry, and options are lost.

KEY—Evaluate each case on its own merits.

3. MULTIPURPOSE SYSTEMS. Joint requirements of all users allow a single, multipurpose unit/system and reduces proliferation.

COMMENT—The concept of the multipurpose system is valid if requirements are identical, or nearly so. More often, the requirements are similar, but differ in degree. Therefore, the tendency is to settle for the "highest common denominator" to satisfy all. (Sometimes called "gold plating.")

KEY—Challenge "unreasonable" requirements and look for trade-offs.

4. MODULARITY. Baseline design consists of the greatest number of common components. Other components are altered/interchanged to satisfy various requirements. (A building block concept with "unique" blocks.)

COMMENT—Often, this is the best way to satisfy user desire for flexibility. Problems arise when unique components are not available where/when needed for employment.

KEY—Insure logistics support.

5. STANDARDIZATION IS A CURE-ALL. This phrase expresses the belief that a simple, readily agreed upon solution means the problem is solved.

COMMENT—Often, the view is too narrow in that only a specific item is considered without full regard for either the variety of applications it may have or the unique features of associated equipment/weapons.

KEY—Analyze the problem and consider the "worst" case situations.

You will find other examples as you go along. Be aware of some of the sour notes in the harmonization scales. One of the best known scales is Service Requirements. Tripping up this scale quickly, we find:

- Language—Not always clear and precise.
- Timing—Unit/System well-defined by one Service with work in progress. Other Service requirements, appearing later, cannot be integrated easily, or, without delay and increased cost to achieve former requirements.
- Parochialism (not invented here)—Service bias based on established policies, "their way" of doing things.
- Personal Ideas—Factor of the man with a pen in his hand. (Own bias or idea(s) of what-to-do).

Another popular scale is the one called Funding, where we find:

- Fencing—The Program Manager has to limit options to avoid undue risk.
- Lead Service Responsible—Costs usually increase for a joint Service item making the original funding inadequate. New funds come "out of the Service hide" and may impact on other developments.
- Service Unique Feature—Delays occur because of trying to "sell" the highest denominator. The Service requiring unique features may have funding troubles also.
- Service Marketeering—High powered sales pitches (white-wash) and out-of-channels efforts—backbiting.

Other scales lacking harmony include *Poor Communications* (between developer, contractor, and user); *Combat Environmental Differences* (land, sea, air); *Doctrinal Differences*; and, *Industrial Motivations* (interfaces, "something different," pricing gimmicks).

The notes on these scales as practiced at present are often dissonant; the challenge to Program Managers is to attain rendition, in tune.

Conclusion

The job of a Program Manager is never easy and it is less easy in those cases where there are multiple customers. The success or failure of standardization in joint programs depends on the people involved. The most important person is the Program Manager—That's you!

- You are the man in charge—so, be in charge.
- You are the man-with-the-plan, so develop—and follow—a good plan.

- You have customers that must be satisfied—communicate with them, listen to them.
- You have bosses who can help you, even protect you—support them, keep them informed.
- You are government's representative with industry—work with industry, keep the good will of industry.

There are many hats that the Program Manager must wear and it's sometimes difficult to wear them well. As stated by Abraham Lincoln, "You can't please all of the people all of the time."

Just remember the objective—we want to standardize, but not for the sake of standardization. The real objective is to enhance combat readiness. Give the troops what they need to do the job when the time comes!

Air Munitions Requirements and Development (AMRAD) Committee

The Air Munitions Requirements and Development (AMRAD) Committee was established in 1969 by Dr. John Foster, then Director of Defense Research and Engineering (DDR&E):

> "... **to effect ... inter-Service coordination ... (and) whose purpose will be to recommend joint use requirements and to advise me (DDR&E) on matters of standardization.**"

Representation is from each of the four military Services. The Chairman, originally designated from the DDR&E staff, serves for a 2-year period. This position assignment is now rotated among the Services. Over time, the Committee has established a close working relationship with the Office of the Assistant Secretary of Defense (I&L).

The Committee has effectively resolved incompatibility issues associated with 20mm ammunition, general purpose bomb fuzes and 2.75-inch rocket motors and fuzes. At the prescribed 1-year review in June 1970, then Deputy Secretary of Defense Packard formalized and amplified the Committee's operation to:

> "... **advise and assist *in ensuring where practical, a congruence of requirements and design standardization of air munitions and related components to fill the needs of more than one* Service.**"

The previous "Charter" became a "Terms of Reference"* document. The Terms of Reference delineated the mission, scope, organization, policy, functions, authority, responsibilities and administration.

These formalities were supplemented, in April 1971, by a Joint Service Agreement wherein the Service agreed to utilize the Committee and the established procedures to harmonize Service qualitative requirements and characteristics for air and related munitions.

Each Service agreed to submit a Requirements/Objective document no later than 9 months after starting advanced development. The AMRAD committee nominates appropriate Requirements/Objectives for joint use and requests comments/recommendations from the Services to establish their interests in standardization. Based on these comments and recommendations AMRAD recommends a standardization category, subject to approval by the Director of Defense Research and Engineering (DDR&E). For joint programs, a lead Service is designated to coordinate the effort and include funds in their budget to develop the item. (Service-unique features are funded by the Service requiring such features.) The lead Service is also responsible for preparing a Joint Service Operational Requirement and, later, a Joint Development Plan. These documents serve as the Service "contracts" to accomplish the tasks necessary to provide the specified munition/weapon system.

Problems occur frequently in development and additional guidance becomes necessary. Occasionally, guidance is requested. The AMRAD Committee has

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*The 1972 revision of the Terms of Reference defined related munitions as those

> "... developed for air-to-ground (applicable) in the ground-to-ground and/or ground-to-air role."

A recent modification expands the AMRAD area of interest to all nonnuclear munitions. Final coordination will authorize a new name: Armaments/Munitions Requirements and Development Committee. The acronym AMRAD will be retained.

been active in several programs in order to keep the programs moving effectively. Assistance, especially unsolicited, is easy to misinterpret as direction, and, on occasion, the distinction may not be too clear. Such misinterpretation is one of the built-in hazards for advisory groups. The AMRAD committee prefers to view this as a challenge and the opportunity to establish solid relations of mutual trust with Program Offices so that a candid, free interchange of information will occur.

Despite the formal procedures and the Services' public position in favor of commonality/standardization, AMRAD work is far from being routine. Each Service understandably prefers to do their own work. Not uncommonly, the AMRAD cajoles and pleads to obtain agreement on joint requirements through re-evaluation, trade-offs, etc. Occasionally, DDR&E may exert direct influence as a "court of last resort." The objective, in all instances, is to get the job done while obtaining the most useful munition/system at least cost to the US taxpayer.

Every dollar saved through reduced duplication is available for another program that might not otherwise have been funded.

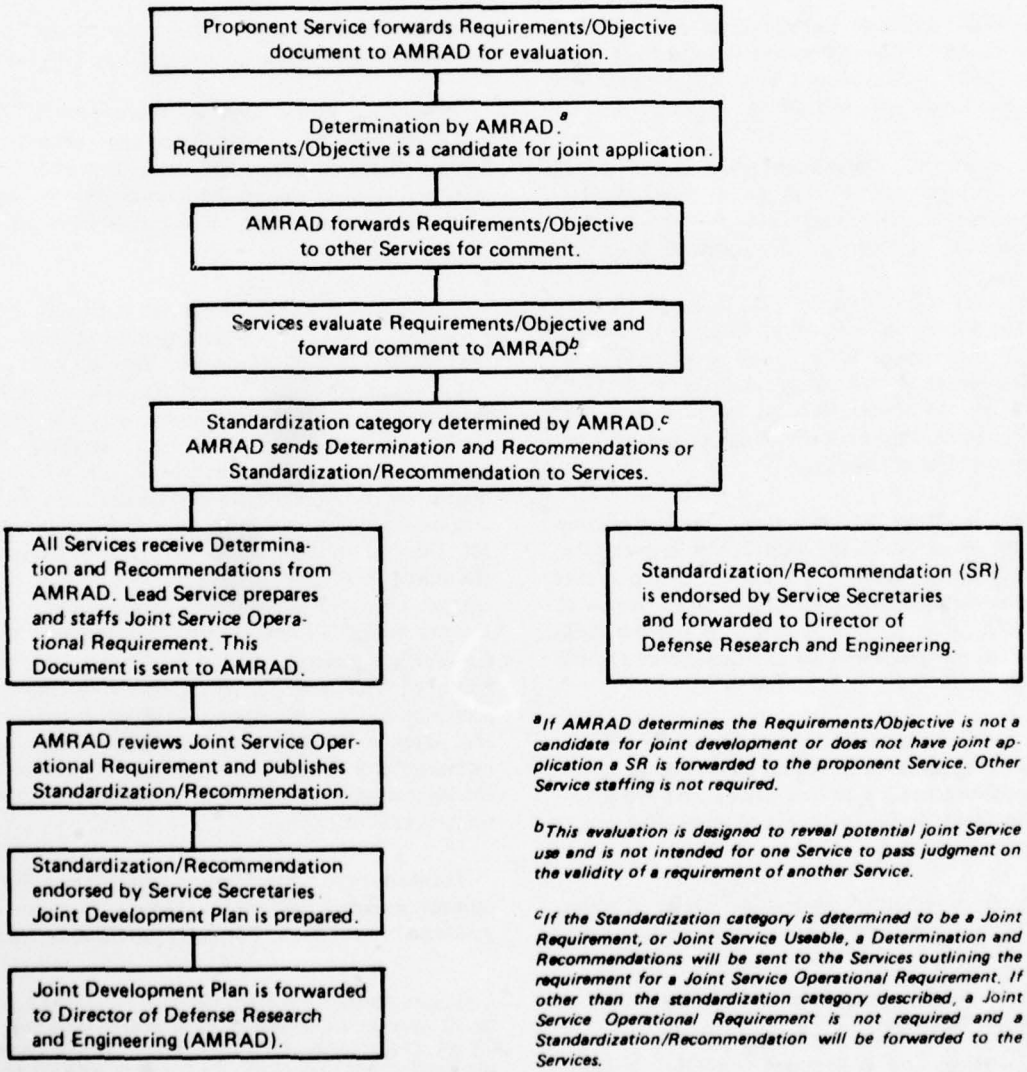

Figure 1. Air Munitions Requirements Documentation Cycle

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Colonel Waddell holds a B.E.E. from Georgia Tech and an MBA from the University of Southern California. He is a graduate of Squadron Officer School and the Air War College.

INTERDEPENDENCE— The Impact on US Security

by

Major John D. Elliott, US Army

The aim of this article is to report on the significance of new initiatives for the NATO Alliance and assess how they may impact on American national security. First, it is essential to understand the NATO definition of standardization and its supporting principles. Second, a review of some of the criticisms and solutions directed at the NATO mechanisms for achieving International Military Standardization is offered as a reference point for evaluating the importance of the new US initiatives.

IMS and NATO

International military standardization (IMS) has been a persistent concern among NATO member nations since 1949 because of the advantages it contributes to overall military effectiveness and cost savings in research development and engineering (RD&E). Initially, with American armament left over from World War II the Alliance achieved a high degree of equipment standardization. Progress in national research and development after the Korean Conflict, as well as other factors such as economic nationalism, changed this. In the fifties and sixties some progress was made on IMS, as the development of the NATO Air Defense Ground Environment (NADGE), and adoption of the Nike, Hawk, and Starfighter weapons systems clearly demonstrate. In view of the magnitude of the overall advantages IMS holds for NATO, these achievements are slight, although they are positive expressions of resolving a difficult problem. The achievements also temper the charge by critics that only "lip service" has been paid to IMS in the past. Recent initiatives by the United States indicate that a breakthrough has been made that will greatly improve the future progress of IMS.

What Is International Military Standardization?

As defined by the *NATO Glossary*, standardization is:

> The process by which member nations achieve the closest practical cooperation among forces, the most efficient use of research, development and production resources, and agree to adopt on the broadest possible basis the use of:
>
> a. Common or compatible operational, administrative and logistic procedures.
> b. Common or compatible technical procedures and criteria.
> c. Common, compatible or interchangeable supplies, components, weapons, or equipment.
> d. Common or compatible tactical doctrine with corresponding organizational compatibility.[1]

This definition sets the boundaries for IMS but more understanding is derived from consideration of the three principles IMS is designed to achieve in NATO. These are *interchangeability*, *interoperability*, and *compatibility* and generally mean:*

> Interchangeability—a condition which exists when two or more items can be exchanged for each other between NATO armed forces.
> Interoperability—the ability of systems, units or forces to provide services and to accept services from other NATO armed forces.
> Compatibility—the capability of two or more items or components of equipment to exist or function in the same system with other NATO armed forces.

*For complete definition see *NATO Glossary*, compatibility, p. 2-62; interchangeability, p. 2-139; and interoperability, p. 2-141.

These principles are a salient feature of IMS which should contribute toward the even broader aim of "rationalization." This term has been defined as "any action which makes more efficient or effective use of the resources devoted by the Alliance to defense." It follows that IMS is a key element of rationalization.

Accomplishment of the principles stated requires mutual research, development and engineering efforts resulting in materiel and nonmateriel (e.g., tactical doctrine) standardization. Dr. Malcolm Currie, while Director of Defense Research and Engineering (DDR&E), in a report* to Congress early in 1976 listed two objectives for US cooperative RD&E efforts:

> (1) Reducing the shortfall, in real terms, between the US RD&E program and that of the Soviets by making greater use of the RD&E of our Allies, and (2) Increasing NATO military force effectiveness through increased common or interoperable hardware and the resultant efficiencies in procurement, training, logistics, manpower, and operational flexibility.[2]

These objectives will be accomplished through the mechanisms for achieving IMS in NATO.

Mechanisms for Achieving IMS in NATO

Today, a primary mechanism working to accomplish IMS in NATO is the Conference of National Armaments Directors (CNAD), of which the Director, DDR&E is the US representative. Interestingly, the CNAD is part of the civilian side of the NATO organizational structure. See Figure 1. By reporting directly to the North Atlantic Council, the CNAD has a direct access channel to forward the results of its forum activities in which it strives "to make cooperation as easy and advantageous as possible" by exchanging information on operational concepts, equipment programs, and technical and logistical matters.[3] Groups comprising the CNAD forum are shown at Figure 2.

The Military Agency for Standardization (MAS) is the Military Committee's primary agency for initiating IMS proposals in conformance with *policy* formulated by the Military Committee. The Military Committee reports to the North Atlantic Council.

*Hereinafter referred to as the Currie Report.

The EUROGROUP* and FINABEL** are two other major mechanisms organized by the European members of NATO that foster IMS within the Alliance. Neither EUROGROUP nor FINABEL have representation from all the NATO countries, yet their deliberations have consistently taken a cast acceptable to most member nations. For example, EUROGROUP's European Program Group (EPG) has made several tangible contributions to NATO infrastructure funds, cooperated in attaining training and logistics objectives, collaborated on equipment developments, and assisted in long-range planning.

The FINABEL contains the core countries of the EUROGROUP with the significant addition of France. Unlike EUROGROUP, it is not affiliated directly with NATO, but organizes its own activities. The objectives of FINABEL, like those of EUROGROUP, stress greater cooperation and collaboration with the aim of achieving more total IMS within the Atlantic Alliance.

Both organizations continue to contribute towards achieving NATO basic aims[4] by providing specific opportunities to ensure a stronger and more cohesive European contribution to the common defense. However, FINABEL definitely offers the best chance for long term success in IMS because both France and the primary common market countries are represented. If the EUROGROUP objectives are met, as outlined at the February 1976 meeting in Rome, a higher degree of European integration in both the military and industrial spheres will be one of its natural products. Accomplishment of the objectives of all IMS mechanisms will be enhanced.

Operation of IMS mechanisms has not been completely free of error or condemnation.

The Problem of IMS: Evaluation/Solution

Simply stated the boundaries of the problem of IMS are established by political and economic conditions. As noted, early NATO military standardization

*The EUROGROUP was founded in 1968 when the French military forces were withdrawn from NATO command. Current members are: Belgium, Denmark, Germany, Greece, Italy, Luxembourg, Netherlands, Norway, Turkey, and the United Kingdom. For additional information see "The Eurogroup," NATO Information Service, Brussels, Belgium, 1975.
**FINABEL preceded the formation of EUROGROUP by several years and current members are: France, Italy, Netherlands, Germany, Belgium and the United Kingdom. For additional information see Michael J. Woodcock, "NATO Standardization," *Military Review*, Oct 1975, pp 42, 46.

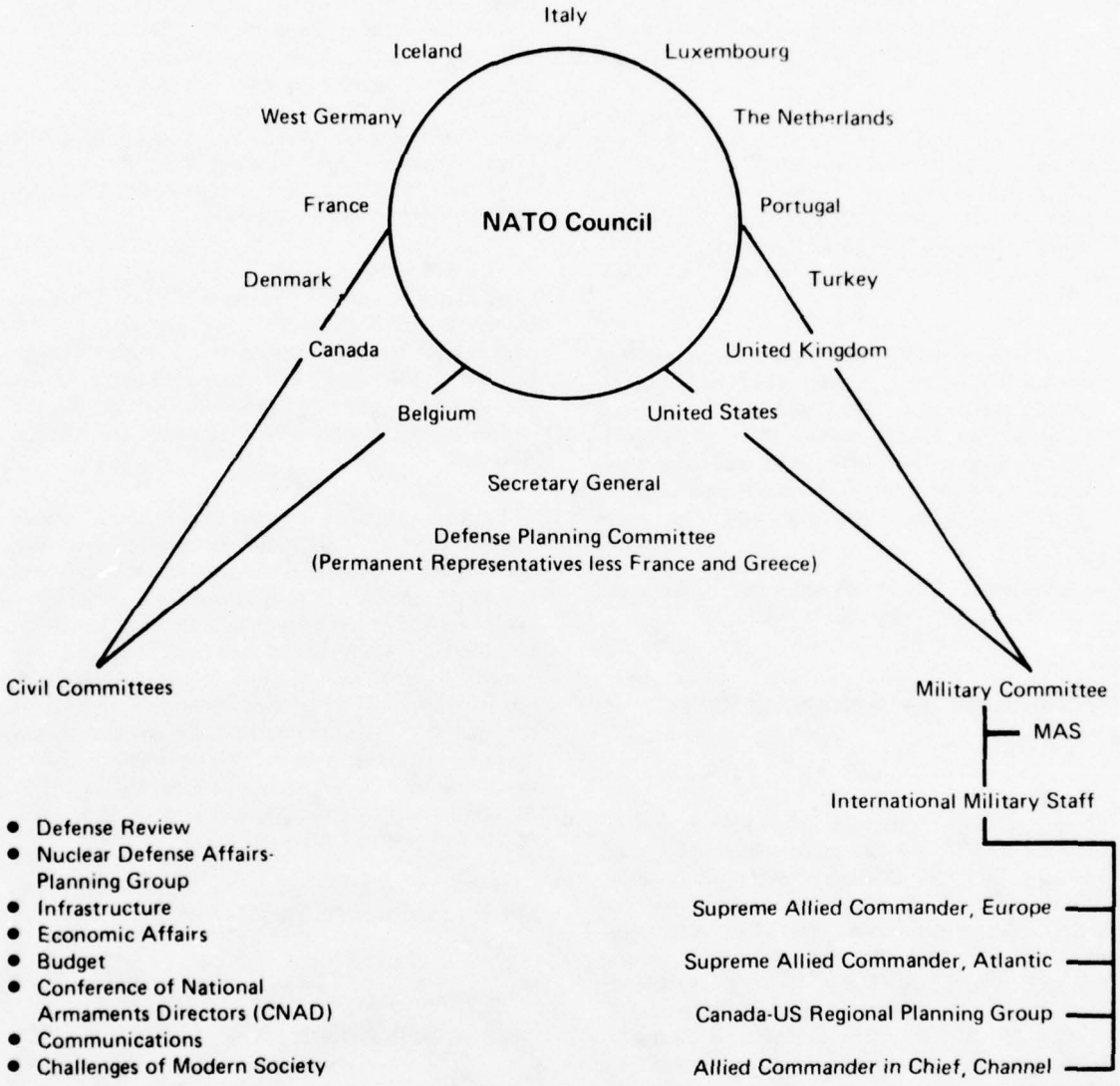

Figure 1. The Nato Organization

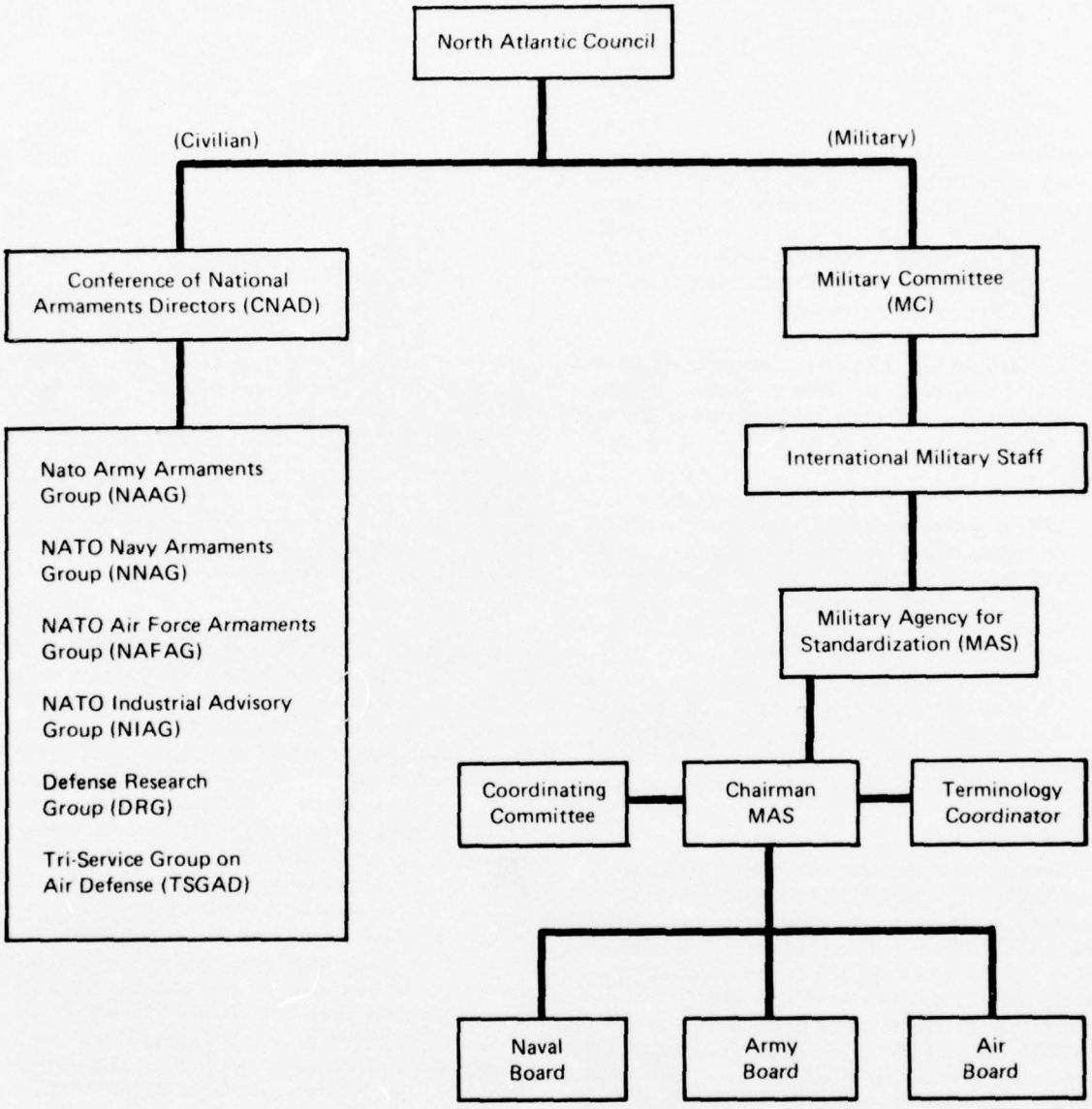

Figure 2. The NATO Standardization Organization

was accomplished by a politically strong US shepherding a NATO strategy of massive retaliation. Economic conditions were not a constraint. Such is not now the case. Today, the extensive and expensive duplication of NATO armaments is recognized as a serious weakness of the Alliance.* Dr. Gardiner L. Tucker, former Assistant Secretary General of NATO for Defense Support, writing in *NATO Review (1976)*, noted that in spite of some notable success NATO has been "destandardizing in many ways in the past several years, so that the variety of weapons in the inventories of the Alliance has been steadily increasing."[5] A review of Table 1 from Dr. Currie's report illustrates the current duplication of equipment types among major NATO Allies. The situation described by Dr. Tucker has not yet changed.

Comparisons like these do not carry the weight of remarks by General Goodpaster, former Supreme Allied Commander Europe, who when recently reviewing some of the faults of NATO strategy concluded:

> Lack of standardization, past resistance to welding air forces into true centralized commands with common systems for their employment, absence of an 'area logistics system' to enable ground forces to be used with adequate freedom of action, disinterest and opposition towards proposals for common procurement programs—all this takes a toll of effectiveness which I have estimated as at least 30 percent, and for some forces 50 percent or more. There is much that could be remedied, *at lower cost*, by adding initiative and more energetic action.[6]

General Johannes Steinhoff, former Chairman of the Military Committee, takes a position similar to General Goodpaster's in his recent book, *Wohin treibt die NATO? (Where is NATO Drifting?)*.[7] He is particularly critical about the absence of standardization in the ACE Mobile Force (AMF).[8] Like Goodpaster and others, he also has good things to say and lauds NADGE, Nike, Hawk, and Starfighter programs while welcoming new initiatives. In his view, NATO will have to become more serious about IMS, if it is to remain a viable Alliance.[9]

Thomas Callaghan's critique expressed in his *US/European Economic Cooperation in Military and Civil Technology* remains the most informative be-

TABLE 1
Duplication of Equipment Types Among Major NATO ALLIES
Source: Currie Report, p VIII-13

Partner	Equipments														
	Helos	Light aircraft	Jet aircraft	Trucks	Tanks	Tactical missiles	Tactical nuclear	Guns and artillery	Ground radar	Avionics	ASW equipment	Computers	Ships	Submarines	Submarine-launched missiles
United Kingdom	x	x	x	x	x	x		x	x	x	x	x	x	x	x
France	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Germany	x	x	x	x	x	x		x	x	x		x	x	x	
Holland									x	x	x	x	x		
Italy	x	x	x	x		x		x	x				x	x	x
Canada		x							x	x	x		x		

cause it is the most analytical. Neither Goodpaster nor Steinhoff argue that they based their percentages of lost effectiveness on any existing data base other than their professional expertise.* But Callaghan has produced a well researched study employing modern techniques of quantitative analysis. The study results reinforce the professional judgment of both Goodpaster and Steinhoff. More importantly, Callaghan addresses IMS on a much broader front by including data on what IMS does and does not do to national defense budgets. For example, he reveals that US/European defense budgets have gone from $18.3 billion per year to $118.4 billion per year over the past 25 years.[10] Callaghan estimates that duplication costs now exceed $10 billion per year, not to mention the limitations in military effectiveness caused by the recurring failure of IMS principles, i.e., interchangeability, interoperability, and compatibility.

Callaghan bases his criticism on the factors that

*This statement is made in consideration of the circumstance that standardization of military hardware and tactical doctrine would detract from some of the flexibility possible through diversity. The advantages of standardization outweigh flexibility in this instance.

*Actually such a study using operations research/systems analysis techniques appears desirable, even long overdue. For a complete review of the NATO and American, British, Canadian, Australian military standardization programs see Delos A. McCoole, *Military Standardization: Its Opportunities and Alternatives for the U.S. Army*, US Army War College, Carlisle Barracks, PA, 1975.

produced the boundaries of the problem mentioned earlier. These factors led to the duplications (now costing billions of dollars) that actually weaken the NATO conventional defense posture.

For Callaghan,

> NATO's conventional forces are (1) qualitatively very uneven, some weak and some strong; (2) inferior to the Warsaw Pact in quantity and diversity; and (3) unable logistically to support one another.[11]

To overcome these and other deficiencies he recommended US initiatives that would develop:

(1) A North Atlantic common defense market,

(2) Cooperation in civil technology, and

(3) Open government procurement.[12]

Callaghan's recommendations have not met with complete acceptance. The formation of a North Atlantic common defense market, the establishment of a functional organization within NATO (like Callaghan's European Defense Procurement Agency), and utilization of a "two-way street" approach to military RD&E and subsequent sales, would make total IMS possible.

Certainly, IMS is not a panacea to solve all NATO problems, but faith in it as a solution to many of its materiel problems is not misplaced. Callaghan's recommendations, over the long-term, should go a long way toward paying the "costs of standardization." Kenneth Booth described these problems in the *RUSI Journal* as:

- Different replacement cycles of different national armies;
- Desire of national governments and industries to maintain employment and keep in the forefront of technical developments;
- Different tactical preferences of national armies (related to their having different battles in mind);
- Typical military preference for their own national equipment;
- Fact that joint production is not always a success;
- Fact that the need to compromise sometimes produces military camels rather than thoroughbred warhorses.

The capstone for this point of view, for Booth, is "*the great unspoken motivation that NATO will not always be there.*"[13]

Decisionmakers in the US are well aware of the problems and are striving for new solutions. This is readily apparent when one considers recent public laws designed to cope with the problems of IMS. These "new initiatives" were begun to ensure greater and more thorough progress.

US Initiatives to Achieve IMS

The US initiatives designed to achieve greater IMS accelerated during the past 2 years. Noteworthy is the fact that much of the weight behind overcoming inertia for developing a "strategy for standardization" has come from the Congress. A growing defense budget and a sincere desire to improve the NATO defense capability have been essential elements of concern to a Congress that feels IMS can both reduce the budget and strengthen NATO.

In 1975 the Culver-Nunn amendment to the DOD Appropriation Authorization Act (PL 93-365)[14] provided a firm indication of the sense of Congress on IMS. This Amendment required the Secretary of Defense to assess the current status of standardization and report the results achieved both to the Congress and to NATO on a semiannual basis. A primary feature of the assessment is an evaluation of the costs and loss of weapons and equipment. The backbone of the report, now submitted annually, consists of

(1) a list of possible actions for standardization, and

(2) an evaluation of the relative priorities and effect. Initial reports have been well received by the Congress.

Department of Defense Appropriation Authorization Act, 1977, PL 94-361,[15] was signed by President Ford on July 14, 1976. This law provides the best insurance policy for IMS yet issued by any NATO country. By this action the US became the leader in developing a "strategy for standardization." Public Law 94-361 amends the 1976 Act, making it US *policy* that equipment procured for US armed forces stationed in Europe be standardized or at least interoperable with that of other NATO members.[16] Details of such procurements will be reported to the

Congress by the Secretary of Defense to ensure compliance with this Law. Moreover, the Secretary of Defense is now specifically authorized to buy other than US equipment to implement the policy. Public Law 94-361 states in unequivocal language that it is the sense of Congress that "weapons systems being developed for employment in the NATO theater shall *conform to a common NATO requirement.*"[17] (italics added)

Accordingly, the Secretary of Defense, working with members of the Alliance, will identify areas for cooperative arrangements and negotiate specific agreements to accomplish the objectives to the *maximum extent possible.*

Lastly, the Congress advises it has accepted the "Two-Way Street" concept of operation advocated in the Callaghan Report. The Congress is encouraging the European governments to accelerate efforts to foster IMS.[18]

At this point, "things are good and getting better" as far as IMS policy is concerned. With adoption of the Allied Tactical Publication (ATP) 33 in 1976, which establishes basic air warfare doctrine for NATO, we are witnessing considerable improvement in the harmonization of NATO tactical doctrine. Agreement on ATP 35 on land warfare will soon follow. But what does this do for American national security? What advantages, and what liabilities does this new emphasis on military standardization convey? This is a subject on which there is even less agreement than there is agreement on the need for standardization.

What Impact Will IMS Have On American National Security?

Independence has been a key feature of American national security policy since Washington's farwell advice to avoid entangling foreign alliances. Yet, both the advice and the feature of independence have demonstrated unique malleability over the nation's history. When required, military technology has been bought, borrowed, and traded to meet national requirements and, in this century, a considerable amount of military equipment has been provided friendly nations. Much of this exchange occurred through the lend-lease program of World War II and the grant programs of the fifties and early sixties. More recently, the United States has been trying to "sell its way to standardization" in the NATO Alliance. Considering the quantity of weapons systems acquired by NATO member nations on a "pay as you go basis," the US has not done badly, particularly over the past 10 years. Why is this now likely to change?

The Europeans have not been dormant in science and technology. Since 1967 when French military forces withdrew from NATO, the big three European Powers–West Germany, the United Kingdom, and France–have vastly expanded the size, capability, and output of their respective RD&E communities. In doing so, they have increasingly found themselves in direct sales competition with major arms producers in the Soviet Union and the United States. That notwithstanding, armament developments have been so successful for these European nations that they now field some military equipment superior to that produced in either the United States or the Soviet Union. Certainly, this did not come as a surprise, given the long history of European successes in weaponry. The surprise is contained in the element of strong competition within the European success.

European technological competition should not be confused with a 1970 version of "*Le Defi Europeen.*" Rather, it should be judged more as admission that Europe has completely recovered its former place in the competitive market place of western nations. This success of the Europeans in military RD&E provides a competitor to the defense policies of independence that have been standard for the Anglo-Saxon nations belonging to NATO. The alternative policy offered by this brisk competition is one of cooperation, but it can result in a degree of *interdependence* not acceptable to some nations. Both Canada and the United Kingdom recognized the advantages of cooperative/collaborative RD&E after the Korean conflict and have modified their defense policies accordingly. The United Kingdom and Canada have an intensive, if relatively brief, history of collaborative RD&E with other nations to develop the military equipments and weapons systems needed to match their roles in world affairs. The United States has viewed interdependence less favorably than any of the Alliance members, with the exception of France.

This drift towards greater interdependence carries with it a perception of possible detrimental impact on American national security. Traditionally, the United States, despite the availability of excellent European and some Asian military equipment, has held to a long-term policy of producing its own. Advantages of this are obvious considering the worldwide military requirements that the United States has had to meet since 1941 to live up to its international political obligations. Since 1812 there has been a constant theme of independence (if not military autarky) in at least the manufacturing of military equipments and weapons systems. In both world wars, considerable use was made of French and British equipment, but Americans moved on to their own as soon as possible.

Since 1945 very little "foreign" military equipment has been purchased by the United States. Military sales has been a one-way street in which the US sold materiel as well as licensing and coproduction agreements rather than buying.[19] This tradition (or arrangement) was broken with the purchase of the French-German Roland air defense system (to produce a modified US version based on foreign developments) in January 1975. Today, negotiations are considerably more extensive with the recent competition between the American XM-1 and German Leopard II tanks representing the best example. In the summer of 1976 it looked as though the decision had been made: the Americans (as expected by the Europeans) had ruled the American tank the winner. Mr. Rumsfeld, then Secretary of Defense, ruled otherwise (perhaps to the amazement of the Europeans) and declared that a decision would be made after further comparative testing and evaluation.[20,21,22] Moreover, Mr. Rumsfeld emphasized the requirement for collaborative efforts of any possible future production to maximize the interoperability, interchangeability, and compatibility of NATO military equipment standardization. At that stage, it was not unfair to predict the acceptance of a hybrid tank incorporating the best features of both designs. This would have produced a NATO tank in the true sense of that term.

Unfortunately, decisions have since been made that preempt fielding a "NATO tank." Chrysler was awarded the contract for the XM-1 in November, 1976. Selection of a main tank gun has been delayed by the US until December 1977, and in mid-January 1977 both the US and Germany announced that each would produce its own tank for its' forces. Work on interoperability will continue, but the dramatic breakthrough that would have vastly expanded the potentialities of NATO military standardization has been contained. Apparently, acceptance of the German tank design would have resulted in a degree of interdependence not acceptable to the United States. The Germans, by all appearances, were more willing to accept these circumstances. In spite of setbacks, the decisions made must be welcomed because they will ultimately advance the overall objectives of standardization and enable greater interoperability than ever possible in the past. Even this conditional success should provide the basis for substantial decisions in the future that will result in standardized weapons systems for NATO ground forces. Such decisions are not new to NATO airforces, who have been narrowing the overall number of aircraft and in 1975, selected the American built F-16 as their standard fighter.[23] However, these decisions are new for ground forces who, with a variety of equipment, resemble Coxey's Army more than modern military forces capable of successfully combating the Warsaw Pact divisions. Other weapons systems will follow the Roland II and the MRCA fighter and will be manufactured within the NATO member nations. The participants will share in the production profits as well as the RD&E costs. This is an important point because according to Major General Richard Bowman, Director, European and NATO Affairs (OASD/ISA), production costs will usually be higher than single-source production.[24] Ensuing military effectiveness of NATO will more than offset this cost.

Willingness to cooperate in military RD&E obviously does not lead to interdependence within a short period of time. Indeed, considering the size and industrial capabilities of some of the national units involved, it may never result in very far reaching interdependence. Broader exchanges of military technology expressed in end products does not automatically result in the subordination syndrome that has been complained about on both sides of the Atlantic and in the northern hemisphere of this continent. In fact, a decision will soon be required on which method—the American or the European—is best for the accomplishment of NATO military standardization. Americans favor an "interdependence" in which RD&E costs are borne by one country with the finished product purchased by the others.[25] Europeans prefer "interdependence" in which RD&E costs are distributed by bilateral or multilateral agreements with the finished products purchased by the developers and the other countries.[26] The use of both these methods will continue with the probable emergence of the European view for the technologically more advanced weapons systems because of considerations such as cost and early agreement on coproduction and licensing. National RD&E may be expected to continue at all cost levels until the policies and NATO military requirements are standardized.

During the near (5 year) and midrange (5 to 10 year) time frames military interdependence attributable to IMS will be limited. Only in the long-range (10 to 20 year) time frame can this projection of interdependence be extended to full reach. Even then it is unlikely that interdependence resulting from collaborative RD&E would pose any serious constraints on American national security. Taking the recent US initiatives on NATO military standardization as a point of departure, a brief review of what could likely be accomplished within the three time frames mentioned above is outlined here.

In the near range time frame, duplication of efforts and the associated expense in resources will decline as the immediate payoffs in NATO forces effectiveness are realized from the standardization of items listed by Dr. Currie "as ammunition, bomb

racks, communications, procedures, training, and logistics support."[27]* In the midrange time frame, where the real advantages and cost savings are, greater progress can be expected on the Airborne Warning and Control System (AWACS), ammunition of all dimensions, the future main battle tank, ground based air defense systems, assault guns, reconnaissance helicopters, and V/STOL aircraft, rocket minelaying equipment, electronic warfare (and compatible IFF systems) antisurface ship missiles, and the NATO Patrol Hydrofoil (PHM).[28,29] New weapons and equipments that are now being conceptualized by the NATO research and development community will contribute significantly to the benefits reserved to the long-range time frame. Immediate preparation of a NATO *overall operational concept,* similar to the *ABCA 86-95 Operational Concept,*[30] to guide research and development of tactics, equipment, and logistics for NATO armed forces during the long-range time frame is an essential requirement for successful IMS in the future. Constructive planning now will further offset any potential liabilities of RD&E interdependence that might emerge in coming decades.

Not surprisingly, some of the new items of equipment listed for the near and midrange time frames will be produced by NATO member nations and "not invented here." This situation will increase the degree of RD&E interdependence that is viewed skeptically by some members of the US defense community. These members are concerned with potential strategic liabilities stemming from greater defense interdependence with NATO Europe. The liabilities are related primarily to the growing economic exchanges between key NATO European nations, especially West Germany, with the Soviet Union.[31] The opposing US defense community members fear that tying US defense RD&E too closely to NATO Europe runs the risk of the US losing control over its own RD&E process in the long-range time frame. That notwithstanding, collaborative RD&E offers an expansive opportunity for cross-pollination of American-European ideas. The resulting improvement of the overall NATO defense posture makes the narrow margin of risk involved worth taking.

Economic considerations are a preeminent factor in all considerations of expanding collaborative RD&E and the resultant military standardization. Virtually any sampling of cost-benefit analysis puts the US ahead financially, regardless of which methods of collaborative RD&E are employed. Callaghan, for example, indicates that Roland II production in the United States will eventually total about $1.0 billion.[32,33]* The expanding science and technology base in NATO Europe makes it impossible for the United States to continue "selling its way to standardization." Moreover, growing RD&E costs make it impossible for Europeans to go it alone on highly expensive weapons systems that utilize the "latest" technology. Adoption of the two-way street policy is a viable approach to achieving the principles of IMS while vastly strengthening the conventional combat power of NATO over the coming decades. There is no doubt that all NATO member nations will benefit from this recent US policy decision, especially NATO taxpayers.

Implementation of new US legislation clearly commenced when Mr. Rumsfeld postponed the choice between competing American tank designs. General Motors and Chrysler were sent back to design major components for competition with a list developed by Mr. Rumsfeld and the German Minister of Defense, Mr. Georg Leber.[34] This precedent will pave the way for other coproduction and licensing agreements, as directed by the Congress in PL 94-361. The action will ultimately produce a new main battle tank emphasizing the NATO principles of IMS. More importantly, it demonstrates US faith in IMS and serves as an example for other NATO Allies who may soon be involved in collaborative RD&E.

Concluding Remarks

General Steinhoff, in his book *Wohin Treibt Die NATO?* referred to standardization as a "magical" word. A multitude of persons have been in favor of standardization in the past and want to see how interoperability, interchangeability, and compatibility will work when combined in NATO armed forces. In the opinion of this writer, the belief in standardization worked for years because NATO suffered under the *illusion* that it was working. This illusion has been dispelled by the recognition of the fact that standardization, to actually work, requires "interdependence" among NATO member nations.

"Interdependence" does not mean subordination of US national security policy to control by other nations in the NATO Alliance or elsewhere. Moreover, existing data indicates that it will not adversely affect America's RD&E base or economic structure. Interdependence does mean:

*Of course near term stabilization may increase some one-time costs for retrofit, redesign and mechanized interfaces, etc.

*See reference 33 for comments on Allied funding of the F-16 and AWACS for additional examples of how the US will benefit.

- NATO can structure its common requirements, to respond to Booth's critique, by setting up similar equipment replacement cycles;
- defense employment can become more stable in the absence of fluctuating demand;
- the sharing of RD&E costs and cross-pollination of American-European ideas will help in meeting the objectives outlined by Dr. Currie;
- tactical preferences can become NATO oriented;
- each member nation can adopt the best equipments and weapons systems;
- joint production can result in more successful thoroughbred warhorses like the Multi-Role Combat Aircraft (MRCA); and
- NATO will remain as a more viable Alliance.

Most importantly, it will now be possible to develop a coordinated long-range operational concept for guiding research and development leading towards total International Military Standardization among NATO member nations. Reinforced by harmonization of tactical doctrine, communications, logistics, and other elements of rationalization, the maturation of IMS policy evinced by recent US initiatives will have positive impact on American national security.

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NATO STANDARIZATION—

An Alternative Approach

by

A. Martin Lidy, Lt Col, USA

Among NATO's ailments is the vast diversity of equipment with which its forces are armed—an impairment from which forces of the Soviet Bloc do not suffer. The results include increased equipment acquisition and maintenance costs, difficulties in logistics support, and restrictions on the ability of NATO forces to operate in concert. Numerous efforts to alleviate this situation have floundered. This author submits a solution lies in standardization.

Part I

Introduction

NATO

The North Atlantic Treaty Organization (NATO) is a political and military Alliance of fifteen sovereign nations. The organization was established in 1949 to halt the westward expansion of the Soviet Union on the European continent. Formed around the residual World War II occupation forces of the western nations, the NATO military establishment has grown to a total peacetime strength of more than 5 million men—the combined annual defense expenditure approaches $140 billion.[1]

Worldwide economic conditions and rising defense costs have served to create political initiatives within the Alliance to manage the burden of defense within resource limits. Member nations realize that if adequate forces are to be maintained, NATO forces must be truly integrated. The imperative actions are to specialize the defense efforts among the participating nations, standardize NATO weapons systems, and increase the interoperability of forces. The increasing costs must be curbed while military effectiveness is achieved. In his address to the North Atlantic Council (Brussels, May 1975), Gerald Ford, then President of the United States, noted:

> A generation after its creation, the alliance wastes vast sums each year, sacrificing military effectiveness. We have simply not done enough to standardize our weapons. We must correct this. We must also agree among ourselves on a sensible division of weapons development programs and production responsibilities. And we must do more to enhance our mutual capacity to support each other both in battle and logistically.[2]

In July 1975, the Secretary of Defense established a DOD Steering Group and a series of working panels. The purpose was to draw together the various ongoing DOD actions relating to rationalization and specialization.[3]

Definitions

Terms as used by the DOD Steering Group are defined below.

Rationalization.—Any action that makes more efficient use of the defense resources of NATO and NATO nationals without changing the total planned defense funding of the member states.

Specialization.—The special conditions within

NATO wherein a member or group of member nations most suited by virtue of technical skills, location, or other tangible assets can perform a specific task, or significant portion thereof, for all.

Standardization.–The process by which member nations achieve the closest practicable cooperation among forces, the most efficient use of research, development, and production resources, and agree to adopt on the broadest basis the use of:

a. Common or compatible operational, administrative and logistical procedures.

b. Common or compatible technical procedures and criteria.

c. Common, compatible, or interchangeable supplies, components, weapons, or equipment.

d. Common or compatible tactical doctrine with corresponding organization compatibility.

Interoperable.–The ability of systems to provide services to or accept services from other systems and to use the services so exchanged to enable them to operate effectively together.

Background

The European nations, owing to the devastation wrought by World War II, had limited economic means with which to equip and field armed forces during the infancy of NATO. In May, 1950, the NATO Defense Committee, recognizing the huge cost associated with defense, recommended

> "... progressive increase in defense forces based on the creation of balanced collective forces rather than balanced national forces."[4]

In general, these urgings went unheeded. The United States was providing a major portion of the armaments for the forces, first through military assistance programs and later by direct foreign military sales. The US actions did provide NATO military forces with standardized equipment–equipment that was for the most part interoperable. To insure against the possibility that the United States might be required to underwrite a major portion of the Allied defense effort as it had during World War II, NATO doctrine established that logistics was a national responsibility.[5]

In mid and late 1950, the European industrial base had recovered sufficiently to permit the joint development and production of exclusively European major items of equipment. The first multinational venture was the FIAT G.91 tactical aircraft program. Initiated in 1954, this program eventually resulted in the delivery of more than 600 aircraft.[6]

Late in 1956, the United States suggested greater coordination in weapons development and production to minimize US cost. Information about US developments became more readily available.[7] The first United States weapons systems selected by NATO for joint development were the HAWK air defense missile and the SIDEWINDER air-to-air missile.[8] This success was followed by other joint projects, each approached on an ad hoc basis. The F-104 STARFIGHTER and the BULLPUP missile are examples of early NATO standardization through joint weapons production.

The attention of the United States, during the 1960s, was directed towards Southeast Asia. The US was then expending sums comparable to about 80 percent of the entire NATO military R&D budget. United States forces were being developed for and deployed to combat operations in the jungles and rice paddies of Asia, not the plains and mountains of Europe. While the Europeans continued joint programs, it was with only limited US interest and participation. The previous degree of standardization achieved through single source development and joint development was eroded by individual national priorities, requirements, and capabilities and by an inability to adjust these items to an agreed international schedule for development. Dr. Gardiner L. Tucker, then the Assistant Secretary General of NATO for Support, was critical of the variety of weapons used by the Allied Command Europe Mobile Force* (AMF):

> With seven nations contributing, there are seven different types of combat aircraft in the air arm; there are six different types of recoilless rifles; four different types of wire-guided antitank weapons; three different types each of mortars, rifles and machine guns. This force is prepared to deploy to a number of different critical areas in time of crisis, and obviously cannot preposition its own supplies in each of these possible areas. Because their weapons and supplies are so

*The AMF is a joint air-ground combat force composed of a reinforced light infantry battalion and supporting tactical aircraft. The force is for use by NATO authorities in crisis situations on NATO flanks to demonstrate Alliance solidarity.

diverse, each of the seven national units in this force must maintain its own logistics personnel and establish its own support. Because the weapons and supplies of AMF units are not standardized with those of the host countries into which they are prepared to deploy, they cannot plan initially to draw on host country supplies and replenish them in due course; they must bring their full supplies with them *ab initio*.[9]

Before his retirement, General Goodpaster, the Supreme Allied Commander Europe (SACEUR), put a price tag on the cost of NATO-wide nonstandardization when he noted that it reduced NATO combat effectiveness by 30 to 50 percent.[10] The United States Congress was quick to respond, and Public Law 93-365 directs the Secretary of Defense

- to undertake a specific assessment of the costs and the possible loss of nonnuclear combat effectiveness of the military forces of the North Atlantic Treaty Organization countries caused by failure to standardize weapons systems, ammunition, fuel, and other military impediments for land, air, and naval forces;

- to develop a list of standardization actions in order of relative priority that could improve the overall North Atlantic Treaty Organization nonnuclear defense capability or save resources for the Alliance as a whole; and

- to bring before appropriate North Atlantic Treaty Organization bodies the results of these assessments and evaluations in order that the suggested actions and recommendations may become an integral part of the overall North Atlantic Treaty Organization development of force goals and review of force goals.[11]

With the high level interest of the Executive and Legislative branches of government once again aroused, the United States Department of Defense must seek options to achieve a truly NATO-wide integrated and standardized force. The military force must be capable of providing peacetime deterrence, and must assure an effective wartime capability.

Part II

NATO Materiel Acquisition Process

The NATO can be viewed as consisting of three major components. These components are the national participants in the Alliance and the civil and military authorities of the Alliance bureaucracy itself. Within NATO, the North Atlantic Council (NAC) is the highest authority. The NAC is chaired by the Secretary General and is comprised of heads of government and ministers of member countries. Each nation maintains a permanent representative, an ambassador and supporting staff at NATO Headquarters, Brussels. Two times each year, ministerial or heads of government level sessions are held. Agendas are developed by the permanent representatives.

The day-to-day activities of the NAC are conducted by various committees. Activities range in diversity from the Military Budget Committee to the Committee on the Challenges of Modern Society. With regard to materiel acquisition the Conference of National Armaments Directors (CNAD) is the most important committee.

The CNAD (in 1966) evolved from what had been the Armaments Committee. The CNAD, was established because

- neither the Armaments Committee nor any other NATO organization has been able to develop a comprehensive system for regular and systematic exchange of information between member nations on either existing or future national systems, whether unilateral or multilateral, and

- machinery did not exist for balancing national industrial and economic interests over the whole range of NATO cooperation in research, development, and production.[12]

Today, the CNAD serves as an Alliance materiel acquisition information exchange body, not as a procurement decisionmaking authority. The CNAD

> "... not only encourages and assists the countries to join together in equipment and research projects, but also provides means for exchanges of information on operational concepts, national equipment programs and appropriate technical and logistical matters where cooperation can benefit NATO and

the nations, even if no particular project as such is likely to materialize. It further encourages discussions on longer-term research activities with a view to providing guidance on the possibility of meeting future military needs through the application of advanced technology or new scientific discoveries."[13]

The CNAD carries out these actions on a daily basis through: a research group, three service main groups and the Triservice Group on Air Defense and about 140 subgroups and information exchange panels.[14] Most members of the armaments groups, the Defense Research Group and the subordinate groups are experts from NATO capitols. Based on agendas developed by the national representatives (NADREPS), the armaments directors meet, generally twice each year, to discuss materiel development and production requirements for NATO forces. The discussion is centered about the political, economic, and technical aspects. Too, the directors provide advice and guidance to the NAC on matters connected with equipping and logistically supporting NATO forces.

In June 1968, the CNAD established the NATO Industrial Advisory Group (NIAG) to support its work. The objectives of this group of industrialists, designated to represent each national industry, are

- to provide a forum for free exchange of views on the various industrial aspects of NATO armaments,
- to foster a deeper feeling of international involvement in research, development and production,
- to seek closer cooperation among the industries of member countries, and
- to encourage timely and efficient exchanges of information between member governments and thier defense industries.[15]

NATO Civil Authorities

INTERNATIONAL STAFF

To implement NAC policy decisions the political structure of the NATO bureaucracy is represented by the NATO International Staff (IS) and is directed by the Secretary General. Of the four Assistant Secretary Generals on the IS, the Assistant Secretary General for Defense Support is the person most concerned with NATO materiel acquisition. His duties and responsibilities, in addition to heading the Defense Support Division and participating as the working chairman of the CNAD, include

- the promotion of the most efficient use of the resources of the Alliance for the equipment and support of its forces. This task especially involves:
  - the encouragement of cooperation between nations in research, development and production and standardization of weapons and equipment and their supply and maintenance within the framework of the defense plans of the Alliance.
  - the organization of exchanges of information which may lead to such equipment.
  - the study of logistic problems including the operation of the NATO Pipeline System, the NATO Maintenance and Supply Organization, etc.
- technical and financial supervision of the NATO Infrastructure program.
- participation in the process of defense reviews on matters within the responsibility and competence of the Division.[16]

MAINTENANCE AND SUPPLY ORGANIZATION

The NATO Maintenance and Supply Organization (NAMSO), is an operating agency subordinate to the NATO Assistant Secretary General for Defense Support. The mission of NAMSO is essentially that of facilitating the supply of spare parts and providing maintenance and repair facilities necessary for the support of certain weapons systems in NATO nation inventories. The major activities of the organization have been to stock parts and maintain European based overhaul facilities for equipment manufactured by the United States and used by non-US NATO forces. The NAMSO can and does serve as a broker for other weapons common to two or more nations. Surprisingly, although the United States was instrumental in establishing NAMSO it does not participate in nor use this agency to any great extent.[17]

NATO Military Authorities

THE MILITARY COMMITTEE

The Military Committee is the highest military authority in NATO. Military Commanders of the

Alliance are subordinate to this body. Organization of the Military Committee is shown in Figure 1. The NAC has charged the Military Committee with

- the peacetime task of recommending those measures necessary for the common defense of NATO area.
- providing military advice and counsel to the NAC.
- coordinating the requests and recommendations of the major NATO commanders.
- providing the direction necessary to implement approved NATO plans and policy.[18]

In addition to the three major commands and a regional planning group, the Military Committee is responsible for two agencies that are involved with the materiel acquisition process. These agencies are the Military Agency for Standardization (MAS) and the Advisory Group for Aerospace Research and Development (AGARD).

INTERNATIONAL MILITARY STAFF

The Chiefs of Staff of the member nations actually constitute the Military Committee but each nation maintains a permanent military representative with supporting staff to effect national participation. The Military Committee is further supported in its day-to-day activities by an International Military Staff (IMS).

MILITARY AGENCY FOR STANDARDIZATION

The MAS was organized in 1951 as the principal activity within NATO to insure that the military forces operate together in the most effective manner. However, the MAS, as an entirely military agency, has had little to do with standardization of armaments which is the responsibility of the CNAD. A review of Table 1 suggests, with the exception of the air panels, most current efforts of the MAS are concerned with standardization of procedures rather than standardization of military equipment.

AGARD

The AGARD was formed in 1952. The purpose was to bring together member nation experts in aerospace science and technology. To accomplish its broad charter of exchanging scientific and technical data, encouraging cooperation, and recommending effective ways for member nations to use research and development capabilities for the common good, AGARD relies on panels, consultant and exchange programs, and technical studies requested by or through the NATO Military Committee.

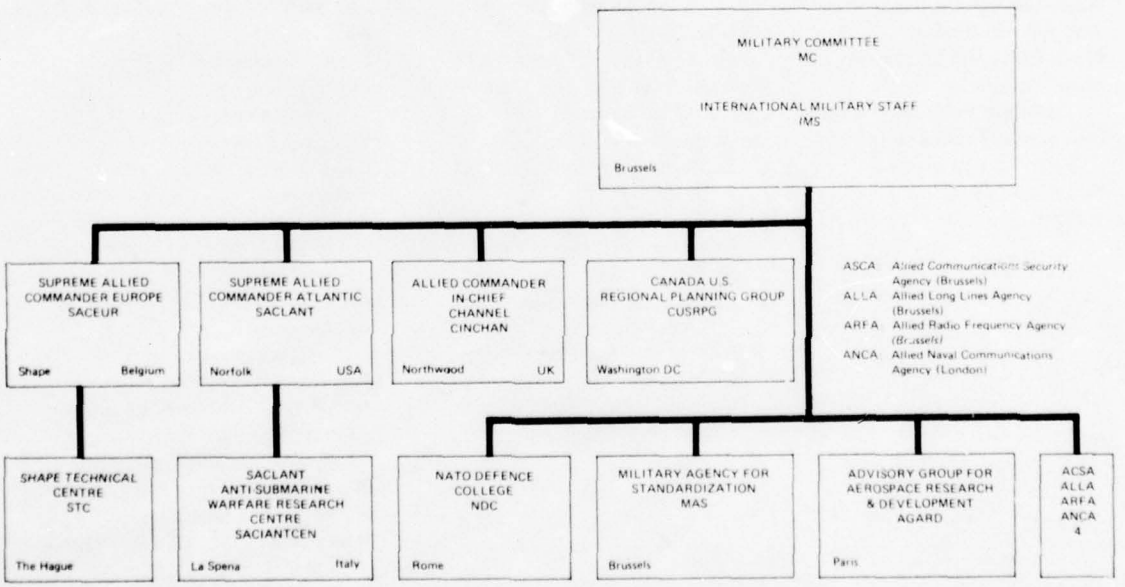

Figure 1. The NATO Military Authority

Source: "NATO Facts and Figures," NATO Information Services, Brussels, Belgium, Oct 71, p 194.

The Formal Acquisition Process

In its early stages, the CNAD sought to foster international cooperation by considering and discussing major items of equipment then under development or in production. This constrained the freedom of choice for CNAD working members and

> "... restricted occasions when nations were willing to commit resources to joint cooperative efforts."[19]

As the off-the-shelf items were exhausted, the working groups were forced to consider future needs. Then it was found that NATO-wide specific guidance upon which acquisition plans could be developed did not exist. By 1968, the CNAD directed the Main Groups to make systematic reviews of all future equipment needs. This action was only partially successful.

As a result of the pendulum swing away from the early procedure of formal NATO equipment requirements being developed by the major NATO Commanders (a procedure that failed to achieve common NATO systems), the 1966 CNAD Charter went to the other extreme and did not require a formal input from the NATO military authorities on equipment requirements. Instead, the stress was on providing an atmosphere to encourage voluntary cooperation by the nations. If only two nations were interested in a cooperative equipment effort, this was considered to be an improvement over the failure of the earlier procedure.

INTERFACE WITH THE CNAD

The Military Committee was given the role of providing the military authorities interface to the CNAD. Unique among NATO Committees, the CNAD contains a member designated by the Military Committee. To provide a direct route for the expression of views by the major NATO commanders, the Military Committee in 1971 directed that:

- the Military Commanders will provide the

Table 1. Military Agency for Standardization Working Panels

Naval Panels	Army Panels	Air Panels
Maritime Tactical Data Cards	Army Fuels and Lubricants	Air Traffic Control
Helicopter Operations from Ships other than A/C Carriers	Combat Clothing & Equipment	A/C Instruments and Aircrew Standardization
Replenishment at Sea	Materials Handling	Interservice Laser Interoperability
Amphibious Warfare	General Medical	Air Electrical
Naval Fuels and Lubricants	NBC Medical	Search and Rescue
Mine Warfare	Movements and Transport	Flight Safety
Technical Publications	Rail Movements and Transport	Electromagnetic Compatibility
Tactical Publications	Land Force Airmobility	Maps and Charts
Exercise Evaluation	Camouflage and Concealment	Lasar Panel on Safe Exposure Levels
Naval Medical	Explosive Ordnance Disposal Interservice	Photo Equipment and Material
RADHAZ	Combat Engineering	Photo Recce Interpretation
	Ammunition Interchangeability	Aeromedical
	Artillery Procedures	Air Transport
	Land Force Operational Procedures	Air Armament
	NBC Operational Procedures	NATO Tactical Air Doctrine
	Intelligence Procedures	A/C Gaseous Systems
	Land Force Tactical Doctrine	Airfield Marking and Lighting
	Land Force Logistics	Aircraft Standard Parts
		Aviation Fuels and Lubricants
		POL Handling Equipment
		Aircraft Cross Servicing
		Interservice Tactical Air Operational Procedures

Source: Ronald E. Wakeford, "NATO Standardization Concepts," SSC-TN-3916-1, Stanford Research Institute, June 75, p 97.

CNAD with agreed Military Committee intelligence,

- the Military Commanders will express opinions and recommendations on long-term, broad operational concepts related to equipment requirements, and

- the Military Commanders will participate as actively as possible at meetings of the CNAD and its subordinate groups.

- SACEUR and SACLANT will support the work of the CNAD by providing the use of the facilities of the SHAPE Technical Center and SACLANTCEN to the extent possible. The same thing was directed with respect to AGARD and the other Military Committee agencies.[20]

The linkage of the military requirements and operational concepts of the military commanders with the main groups of the CNAD provided the mechanism to anticipate future requirements. Starting equipment discussions before nations become committed to a specific course of action should provide a better basis upon which to reach agreement. Since 1970, the CNAD working groups have evolved into forums in search of cases in which NATO future collaboration on weapons development and production can be achieved. The working groups hold 3 to 4-day sessions involving military, scientific, and technical experts two or three times each year. Draft positions on weapon systems are coordinated with national authorities. Formal recommendations are presented to the CNAD for consideration.

NATO PROJECTS

Based on specific recommendations of working groups, the CNAD may elevate a major weapons system to the status of a "NATO Project." Current NATO Projects are listed in Table 2. Once a system receives this designation, the developing nation(s) work collectively to produce the system. Other nations with interest in the system can arrange for purchase. In the case of the more complex NATO Multi-Role Combat Aircraft Project (MRCA), an intergovernmenal body was established to manage the project.[21] The elevated status provides international recognition to what would otherwise be merely bilateral or multilateral activities. An appropriate NATO Steering Committee is established to monitor and assist participants and report the project status to the CNAD.

The formal NATO materiel acquisition organization brings the three organizational components together. The dependent groups, or subgroups, operate under appropriate main groups and conduct detailed weapons studies in support of the CNAD.[22]

Operating Alternatives to the NATO Process

The CNAD is rather unwieldy because of its size and the diverse interest of its members. Because of this, three smaller subgroups with common interests in materiel acquisition have been created to supplement the efforts of the CNAD. The subgroups are EUROGROUP, the Four Power Group and the Independent European Program Group (i.e., EUROGROUP members and France).

In 1968, Belgium, Denmark, The Federal Republic of Germany, Greece, Italy, Luxembourg, the Netherlands, Norway, Turkey, and the United Kingdom formed the EUROGROUP as an instrument of cooperation, consultation, and coordination within the formal NATO organization. The specific purposes of the EUROGROUP are

- to achieve, by collaboration, effective use of their financial resources and greater efficiency in their national defense efforts;

- to facilitate, by multilateral improvement programs, the US force presence in Europe politically, psychologically, and materially; and

- to consult with each other on matters relating to security and defense, and above all, develop common equipment, training, and logistic concepts.[23]

The EUROGROUP, even without French participation, has produced results in expanded cooperation. The European Defense Improvement Program fi-

TABLE 2, Current NATO Weapons Systems Projects Source: "NATO Facts and Figures," NATO Information Services, Brussels, Belgium, Oct 71, p 133.

NATO JAGUAR Tactical and Training Aircraft
NATO SEASPARROW Point Defense Ship Missile
NATO Azores Fixed Acoustical Range
NATO AN-USD 501 Surveillance System
NATO FH-70 Towed Howitzer
NATO Acoustic Communication with Submarines
NATO PUMA, GAZELLE, and LYNX Helicopters
NATO Multi-Role Combat Aircraft
NATO ZENDE Locating Radar
NATO Combat Vehicle Reconnaissance (Tracked)

nanced an extensive shelter program for aircraft in Europe. The EUROGROUP nations increased defense expenditures by 37 percent (from 1970 to 1973) in monetary terms. The United States increase was one percent.[24] The EUROGROUP success in promoting weapons standardization is apparent from a review of the list of NATO projects. Most of the projects are based on European development and are of European origin. The EUROGROUP efforts demonstrate that the Europeans have the will to identify and develop areas of cooperation and are capable of doing many things for European defense on a totally European basis.[25]

The second formal subgroup, (the Armament Directors of the US, UK, France and the FRG) was established to provide less formal body to harmonize the national materiel development programs of the main producing countries of the Alliance. This, the Four Power Group, is comprised of the chiefs of defense research and development of France, the Federal Republic of Germany, the United Kingdom, and the United States. The Four Power Group meets every 6 months. Each national project is reviewed by phase of development. Projects are examined with a view toward cancelling duplicative national planned programs in favor of a common solution.[26] Since these four countries expend about 98 percent of the combined NATO defense research and development funds, the Four Power review process encompasses virtually all major NATO weapons developments.

A significant problem facing the Four Power Group is harmonization of the national phases of materiel development. The United States acquisition process is based on four distinct phases. Control of major systems is exercised through reviews by the Defense Systems Acquisition Review Council (DSARC) and Secretary of Defense approval (between each phase). Other members of the Four Power Group use from three to seven phases of development. See Table 3. Because of a paucity of available data, it was not possible to determine what national materiel acquisition control is exercised within the Four Power Group countries.

Apparent Problems within the Existing Framework

Despite urgings of the Defense Committee to create balanced collective forces rather than balanced national forces, only now is NATO beginning to consider rationalization and specialization of its defense forces. *The NATO doctrine maintains that logistic support is a national responsibility.* With a vast organization devoted to equipment technology and development exchanges, NATO equipment standardization has achieved only a modicum of success. The NATO forces maintain a plethora of costly weapon systems less standardized and less interoperable than economic common sense should allow. Many critics of the process have addressed the problem of standardization. The resultant observations suggest three major problem areas within the NATO organizational framework.

DECISIONMAKING

Since NATO is an Alliance of sovereign nations, all decisionmaking is based on joint consultation. Each member nation then is free to take whatever course of action it deems appropriate. There is no supranational authority vested with the power to compel a nation to take a specific action. As a result, the CNAD is merely a body that encourages

TABLE 3, Four Power Group Materiel Acquisition Phases

United States[27]	France[28]	Federal Republic of Germany[29]	United Kingdom[30]
Concept	Conceptual study	Lead phase Concept phase	Feasibility study Project definition
Validation	Feasibility study	Definition phase	
Full scale development	Exploratory development Completion of drawings and manufacture of toolings	Development phase	Full development
Production and deployment	Mass production	Procurement phase Service phase	

and assists cooperation through information exchanges and discussions of national development programs.

Tyler Port, a former NATO Assistant Secretary General for Defense Support, has suggested that the problem facing NATO is

> "...how to bridge the gap that exists between the vast amount of organized information developed at the information exchange level and the decisionmaking process at the national level."[31]

The CNAD as a body does not possess authority to make materiel acquisition decisions for nations. The CNAD may assist in cooperative efforts once the nations have decided on a course of action. The CNAD consists of national representatives who are supposed to have authority to make weapons acquisition decisions for the respective national defense establishments. The actual decisionmaking process apparently has not been successful because the supporting apparatus (main groups, subgroups, and panels), have been unable to assimilate the huge quantities of technical information and to present the decisionmakers with clear, concise, and rational sets of choices from which decisions can be made. The Four Power Group has been less than successful since its staffs are nationally oriented. New programs are considered only in various phases of research and development; the Group does not seem to coordinate at procurement thresholds.

MANAGEMENT OF THE MATERIEL ACQUISITION PROCESS

The CNAD supporting organizations are part-time working groups consisting of national representatives and selected members of the international and military staffs. Facer[32] has suggested that the existing organization does not allow for agreement on common requirements much less a system to meet the need. Certainly, the national representatives to the various CNAD groups tend to be strong advocates of national programs. A 15-man working group meeting only periodically and subjected to strong national biases is not the best forum in which to agree upon common military requirements or to make difficult choices for the Alliance as an entity. Because of this deficiency the CNAD replaced the old Armaments Committee. The NATO weapons acquisition process is much like a 15-man lifeboat cast adrift without a rudder. Navigation depends upon coordination of the oars. Unless the oars are coordinated, especially the strongest ones, the course will be chaotic. Facer believes the EUROGROUP, provided it secures French participation, can serve as a compensating alternative to the dominance and to the rather unpredictable United States participation in weapons standardization.

Facer observed that there is no body at the international level with responsibility for harmonizing national equipment replacement plans. While the CNAD working bodies do have Military Committee representation, there is little agreement on which weapons to select. There is less agreement on what the Alliance-wide priority for introduction should be. Instead, when a weapon is selected for multinational use, each nation deals with the producer directly. The producer then establishes a production and delivery schedule generally on a first come first served basis without regard to Alliance priorities. Additionally, there is no coherent international planning for Alliance-wide mixes of weapons. Neither are international plans developed to extend the useful life of older systems. Rather than promoting management by weapons family, NATO exchanges information on an ad hoc and rather random project-by-project basis.

CENTRAL PROCUREMENT

The NATO does not have a standing procurement activity to support an Alliance purchase of common weapon systems. For large projects such as the MRCA, multinational consortiums are established. Because there is no international management, national weapons procurements usually are negotiated directly with national or international manufacturers and without regard to production economies of scale or Alliance priorities. Most countries procure from one or more foreign manufacturers. Hence the financial drain that each project imposes on the national balance of payments becomes increasingly important as system costs increase. Many times the balance of payments becomes the controlling factor determining the size of the procurement and the timing of the expenditure.

James[33] called for a central direction to procurement and common funding of procurement at least on a modest scale. He recommended that a European Procurement Agency be established so that the procurement accounts of European nations could be adequately balanced internally and balanced with those of the United States. Callaghan[34] supports the central procurement concept but suggests that national accounts should not be balanced on a project or annual basis. He cites the United States–Canadian Development/Production Sharing Program with a record of 34 years of bilateral success. Callaghan observes that wide variances between these two nations

have occurred but that a long-term balance has been achieved.[35]

The 1970 Western European Union (WEU) study was critical of the duplication of 12 ministries of defense for each of the European members of NATO. Reason: fully 90 percent of the defense spending of these member countries is NATO related. The study went further than the James solution. A recommendation was that all 12 defense establishments merge to achieve greater efficiency and effectiveness without increasing the overall cost of defense. Such merger would centralize European defense procurement in a single authority.[36] Recognizing the practical limitations of this recommendation the WEU study committee suggested, as an alternative, that each nation remodel its defense organization to be more compatible with that of its neighbor. In this way rationalization and specialization of the European defense effort can be achieved over the longer term.

In the area of weapons procurement, the WEU study committee further recommended that the twelve countries agree to ten weapons projects that would come into service within the next decade. Each weapon would be assigned to a specific country for research and development but all nations would agree to buy the ten systems (with no alternatives permitted) when the production stage was reached. Offered would be a package deal of weapons research, development and procurement. Because of technological constraints, there are few NATO nations that can unilaterally develop and produce an entire modern weapons system. While subcontracting or licensing might be alternatives, Callaghan cautions that such measures probably will be costly. He cited the British F-4 PHANTOM licensing experience that resulted in twice the cost for about half of the number of aircraft—aircraft that the British could have purchased directly from the United States.[37]

To bring all members of the Alliance into sharing the development of a new weapons system, total life cycle procurement must be considered. Spares, ammunition, repair facilities, or training ranges to maintain readiness may be the only contribution that some nations can offer to help offset the cost of purchases. If only the acquisition costs are considered, most countries will incur deficit balances. If life cycle costs are accounted for on a weapons family basis, then all nations probably can provide at least some portion of the total requirement. A central NATO procurement agency would permit nations

- to take advantage of long-term production runs,
- to schedule deployments based on Alliance-wide priorities,
- to share the cost burden for new weapons procurement, and
- to maintain relatively balanced defense accounts.

Part III

An Alternative Approach to Achieve NATO Standardization

Problem Overview

The NATO materiel acquisition process that now exists has evolved from various formal organizational iterations, and even informal parallel alternatives developed within the formal framework. While the Four Power Group and CNAD now provide possible mechanisms for effective management, the missing catalyst common to every attempt to make the process a viable one appears to be the lack of centralized responsibility and authority. Instead, NATO continues to rely on committees to manage the Alliance materiel selection process.

If the problem of weapons standardization is as important as the military and political leaders emphasize, NATO can no longer afford to rely solely on information exchange panels, committee meetings, or armaments symposia in the hopes that these will result in the best recommendations for the Alliance. Weapons acquisition is a complex and costly business—a business requiring strong professional leadership supported by military and technical expertise. Such leadership and support is necessary so that specific technical requirements can be established, alternative plans evaluated, and sound recommendations for action formulated. The authority and responsibility for these tasks must be vested in individuals if timely and credible results are to be obtained.

The lack of a NATO Procurement Agency works

to the disadvantages of the Alliance. If a NATO Procurement Agency were established for materiel acquisition and support, the Alliance would be in a position to reap the benefits of:

- longer production runs,
- equitable production distribution among all nations of the Alliance, and
- Alliance-wide standardization.

The weapons systems would be purchased by nations for their forces, through the international agency. The procurement agency would serve the collective effort of the Alliance rather than purchasing commonly owned equipment for the Alliance.

First Steps

As a positive first step toward achieving improved weapons standardization within NATO, I recommend the establishment of a permanent staff of Weapons Family Managers (WFM) and a NATO Procurement Agency (NPA). I suggest both the WFM and NPA be part of the Alliance organization structure, subordinate to the NATO Assistant Secretary General for Defense Support, (the senior person within NATO responsible for efficient use of Alliance resources in equipping and supporting its forces).

Weapons Family Managers

For two decades, the project manager concept has been an important innovation for management of complex tasks involving numerous governmental and industrial entities. The Weapons Family Manager approach would be based broadly on the Program Management concept. A WFM would be designated for each family of weapons or equipment, based on logical groupings by military role and technical performance characteristics. A list of ground force WFM is contained in Table 4.

The typical WFM Office probably would consist of 25 to 40 military and civilian personnel who have had previous national or international weapons acquisitions experience. The specific responsibilities of the WFM would be to

- serve as the NATO interface with: the military users, the NATO intelligence activities, national weapons acquisition agencies, and the NATO Procurement Agency.
- establish the NATO functional baseline technical requirements for all weapon systems within their family.
- assess the existing NATO weapons inventories and future plans for commonality, munitions, spares, etc.
- assess new weapons candidates currently in conceptual or validation phases of development.
- accept that the Four Power Group has even less official recognition in NATO than the EUROGROUP, and is looked on with askance by some nations and some elements of the International Staff.
- develop and recommend to the entire CNAD an Alliance-wide plan for their family of weapons based on considerations of total life cycle costs and system effectiveness that
  - introduce new weapons by military priority,

TABLE 4, Ground Force Weapons Family Managers

Family	*Weapons/Equipment Group*
Indirect fire systems	Artillery, mortars, multiple rocket launchers, etc.
Combat vehicles	Tanks, reconnaissance vehicles, personnel carriers, etc.
Antitank and small arms	Antitank missiles and rockets, auxillary or man-carried weapons 40mm or less.
Air defense	Air defense guns and missiles, radars, etc.
Aircraft	Helicopters, light fixed wing, etc.
Communications systems	All communications systems used by ground forces.
Support equipment	Special purpose equipment used in engineering, chemical, maintenance, etc.

- establish high-low mixes where appropriate, and
- extend the useful life of older systems when possible.

- serve as the single NATO point of contact for information concerning their family of weapons.

Assume the Four Power Group nations produce about 98 percent of the Alliance R&D effort. Particularly all new major weapons systems in the conceptual, validation, or full scale development phases will be in development in one or more of these nations. The senior positions within the WFM Office should have military representation from each of the four nations, probably at the flag rank to facilitate coordination with national and international authorities and, to bring together the knowledge of the various individual national weapons management processes. One possible method of assigning responsibility for senior personnel is indicated in Figure 2. Assignments could be made on a rotational basis. For continuity normal tenure should be for a minimum of 4 years. Other members of the WFM Office would be concerned with engineering, integrated logistics support, configuration management, planning, procurement and production. These positions would be tailored to meet the specific needs of each WFM Office and could be filled by any nation of the Alliance. In this manner, the WFM could serve to develop national expertise in materiel acquisition. As staff members returned to their own nation agencies they would take with them the expertise gained.

Weapons Family Manager*		
Deputy for Concept and Validation *	Deputy for Full Scale Development and Testing *	Deputy for Production/ Deployment *
Engineering	Integrated Logistics	Configuration Management
Planning	Procurement	Production

*Senior Four Power Group Member

Figure 2. The Weapons Family Manager Office

The WFM would operate as an integrator of international military requirements with the researchers and developers of various national ministeries of defense. The WFM must examine the military need within his area of concern, and consider choices to meet it. Discussions with the military force structure and logistics planners about current and future plans would provide essential understanding and the basis upon which to develop a harmonized NATO-wide modernization plan within the family of weapons that each WFM manages. By drawing on the functional expertise of the NATO Maintenance and Supply Agency, the NATO Procurement Agency, when necessary the Infrastructure Committees, and perhaps an AFCENT Support Command, as recommended by Komer,[38] the WFM Office can formulate an effective, efficient, and comprehensive plan for the Alliance to equip and support its forces. The WFM Offices could replace the Armaments Groups of the CNAD and bridge the gap that now exists between the vast amounts of information and the national decisionmakers.

Once the technical baseline requirements were established for the weapons family, the WFM would examine the specific options available to meet the need. Based on analyses and technically supported by AGARD, the SHAPE Technical Center and SACLANTCEN, the WFM would make recommendations to the Four Power Group. The WFM would recommend the selected weapon system for NATO full-scale development. Under certain circumstances, and if costs permit, it might be desirable to continue with two prototypes during full scale development and operational testing before selecting the final candidate. A simple majority vote of the Four Power Group Armaments Directors would constitute the NATO systems acquisition position for the full scale development phase. In the event of a split vote, the Assistant Secretary General for Defense Support would cast the deciding vote. The decision would not compel the nation or nations that were not selected to cancel their programs. Program development could continue—but with the understanding that a nonstandard system, with limited potential for NATO sales, was being developed. A rational approach for these nations to follow would be to pool research and development funds to strengthen the selected effort and eliminate expensive duplication.

The WFM would closely monitor the program during full scale development, and provide NATO assistance if required. The WFM would arrange for NATO observation or participation in operational testing to insure that the system meets international requirements. In this period, the WFM would continue to refine its acquisition, deployment, and support plans with the national ministeries of defense and the NATO functional agencies. When the full scale development phase was completed, the plans could be consolidated and presented to the CNAD for concurrence. Once approved by the CNAD, the

WFM plan would become the NATO common position for the production, deployment, and service phase for the system.

NATO Procurement Agency

The NATO Procurement Agency would be a permanent functional activity to serve as a focal point for all international weapons procurement within the Alliance. Establishment of this Agency would eliminate the need to establish consortiums on an ad hoc basis. The success of the NATO Infrastructure Program in handling commonly funded projects for the NADGE, NICS, and other efforts is a precedent that might be followed by the NPA.

The NPA would establish contact with national defense industries through the NATO Industrial Advisory Group of the CNAD. The major function of the NPA would be to support the Weapons Family Managers and the NATO Maintenance and Supply Agency. The NPA would provide contracting and procurement support especially during the production and service phase of the system life. Further, the NPS would develop work breakouts across all member nations within national capabilities for the system and its support. To achieve national cooperation in standardization all nations must share a piece of the action. Costs, schedules, and technical performance will be paramount considerations, but the NPA must also take into account the international balance of payments status and the diversification of the production base. All these factors were evaluated in the European selection of the F-16. One of the most significant selling points was

> "...work equivalent to 40 percent of the value of the aircraft ordered in Europe is to be undertaken there."[39]

The NPA would be the functional agency to accomplish the breakout for the Alliance equipment procurement requirements.

The NPA must monitor and keep track of the international balance of defense procurement accounts, a politically sensitive activity. Callaghan's suggestion that national accounts should not be forced to be balanced on a project or annual basis should be heeded. Variances will exist, but management control should work toward equitable resolution. Because of the high level political interest that will be associated with the procurement activity, the NPA should develop and recommend to the Council of Ministers a formula (for the NPA to follow) and the range of variances that will be tolerated. Once approved by the Council, the status of the national accounts would be reported annually at the Spring ministerial session so that the amount, the trends and the management actions to be taken are known to the political leaders of the member nations.

Cost vs Benefit of the Alternative

There is no doubt that the alternative proposed here will result in a larger NATO bureaucracy. The additional manning might range from two to four thousand full-time staff members, depending on the final organization of the NATO Procurement Agency and the number of Weapons Family Managers designated. Assuming an average annual direct and indirect cost of $50,000 per staff member for salary, travel, and overhead expenses, the cost to member nations might be as high as $200 million each year if savings cannot be realized by eliminating the CNAD Main Group and other panels. Some spaces may be transferred from the International Staff, SHAPE, or the Technical Centers of the major commands. Collocation of activities with national agencies might reduce costs further.

As noted earlier the penalty for nonstandardization has been estimated at a 30 to 50 percent reduction in combat effectiveness. Another estimate is that the Alliance wastes more than $10 billion of its precious defense resources each year in duplicative research, development, production, and logistical efforts.[40] If these cost estimates are approximately correct, the alternative would break-even if only a two percent reduction in nonstandardization were achieved. At this breakeven point a concomitant no additional cost improvement in combat effectiveness of about one percent would be expected.

Analysis at this level cannot prove the optimality of any alternative approach. The potential for significant direct savings, at a token cost, clearly does exist. For these costs, the subjective probability assessment that the alternative will fail would have to be greater than 98 percent for the expected value of the efforts to be negative. The United States DSARC system, supported by the project management concept provides a working analogy that has demonstrated the feasibility of the approach at the national level. To expect as effective a system at the international level of operation is not realistic. Nevertheless, high-level political interest in achieving defense economies will certainly insure that any attempt to achieve greater standardization will have less than a 98 percent chance of failure. I feel that the benefits that might accrue would far outweigh the cost risks associated with the alternative.

Decision Points and Dimensions

The Weapons Family Manager concept can provide the catalyst essential for centralized management of materiel acquisition for NATO. By translating military requirements into technical baselines, examining options and making choices, the WFM can make the Alliance weapons acquisition process function as the military and political leaders have indicated that it must. By imposing two formal decisions points for NATO projects, the Four Power Group approval before entering full scale development (DSARC II equivalent) and the CNAD approval prior to production and deployment (DSARC III), the responsibility for decisionmaking becomes more clearly defined. The formal decisions then become the documented NATO course of action. The mechanism for efficiently equipping and support NATO forces would be established on a permanent rather than an ad hoc basis.

The NATO Procurement Agency would add a permanent dimension to the centralized management of international procurement. As the number of common procurement projects increase, it should be possible to balance national accounts while providing all member nations participation in equipping and supporting the entire Alliance forces.

Part IV

Summary, Recommendations and Conclusions

Summary

In this article actions are reviewed that have established the need for the Department of Defense to develop and implement policies to make NATO standardization a reality. The summary of past NATO cooperation in the areas of standardization is intended as prologue.

Within the framework of the NATO organization model, specifically, the framework and elements of the materiel acquisition submodel, national participants and civil and military staffs do interact for the purpose of achieving cooperation in research, development, and production of standard weapons and equipment. The organizational model that now exists has evolved over time. The model remains unwieldy. This has been recognized, and two subgroups (the EUROGROUP and the Four Power Group) have been established to facilitate the materiel acquisition and standardization process.

The EUROGROUP, predominantly European but excluding France, has been uniquely successful during its short existence by increasing the European contribution to the NATO defense and by fostering strong European cooperation toward achieving weapons standardization during development and production. The Four Power Group, consisting of the Federal Republic of Germany, France, the United Kingdom, and the United States, contributes about 98 percent of the total NATO military research and development effort. This group meets semiannually with the primary purpose of eliminating research and development duplication.

To date NATO attempts to achieve standardization have been less successful than national defense budgets and common sense dictate. Many have criticized the NATO materiel acquisition and standardization system. For purposes of analysis, these criticisms have been grouped into three categories—decisionmaking, management, and centralized procurement.

An alternative to the armaments groups of the Council of National Armaments Directors (CNAD) has been offered in this article as a remedy to the problem of management. The alternative is based on the concept of project management and establishes Weapons Family Managers for weapons of like function and performance. Specific management responsibilities for the WFM have been defined and discussed. The discussion is intended to surface the complexity of the management activities that to date have been the responsibility of committees.

The suggestion that a centralized NATO Procurement Agency be established is supported. Such agency would facilitate the standardization process by insuring

- that each nation participate in the process,
- that national defense accounts are monitored and managed toward achieving a more equitable balance over the long term, and
- that the advantages of longer production runs and diversification are achieved.

If the management and procurement aspects of the problems are rectified, the decisionmaking authority vested in the Four Power Group and the CNAD can be used to define and establish the necessary thresholds for NATO materiel acquisition decisions and ultimate standardization.

Recommendations

Without the leadership and direct participation of the United States, any program to achieve NATO standardization will be less than optimal. Five significant problem areas have been identified explicitly or implicitly in this paper. These areas required further examination. Indepth examination should result in DOD implementing policy decisions and plans for action. These areas are discussed in order of importance.

FORMULA FOR BALANCING ACCOUNTS

Past performance of the United States in the area of Foreign Military Sales with NATO Allies has resulted in an overwhelming market dominance to US advantage. This dominance must be tempered if the Allies are to be expected to cooperate with rather than compete against the United States for a fair share. A time-phase formula for balancing defense accounts that is equitable and acceptable to all member nations must be derived. This formula and the variance thresholds that will be tolerated can then be employed by a centralized NATO Procurement Agency to support its management task.

KNOWLEDGE OF NATIONAL MATERIEL ACQUISITION PROCESS

Members of the US Department of Defense must better understand the materiel acquisition processes of the NATO member nations—in particular the processes of the Four Power Group nations—if the DOD is to lead effectively and participate in any successful NATO standardization effort. A detailed study of the German, French and British materiel acquisition systems should be undertaken immediately, and those of the other nations as soon as possible. The results of these efforts should be developed for incorporation in a course on international materiel acquisition that can be made available to all member nations of NATO.

LOGISTICAL PLANNING AN INTERNATIONAL RESPONSIBILITY

Generally, the operations and maintenance costs associated with a weapon system during its lifetime dominate the acquisition cost of the system. Even if NATO can achieve some modicum of success in the area of acquiring standard weapons, without an international level and scope of planning for integrated logistical support of the system, cost savings will be token. The United States must take the lead, as it did during the formative years of NATO, to establish a policy of international planning in the area of logistical support or in the organization of a common approach analogous to the NATO Infrastructure Program.

THE FRENCH ROLE

France has remained apart from NATO since President De Gaulle limited direct military participation in the Alliance. France has also remained outside the EUROGROUP. The United States must decide what military participation it would expect from France for supporting a wider and stronger role for France in the NATO materiel acquisition process. The potential economic advantages of a system organized around the Weapons Family Manager concept certainly should be used as leverage to encourage more French military participation within the Alliance.

OTHER SERVICE WEAPONS FAMILY MANAGER

While ground forces have been used to illustrate the concept, the Weapons Family Managers for other services should be defined, developed and incorporated into a comprehensive plan for NATO implementation. The same concept might be adopted in other support areas such as the Infrastructure Program and common services for the Alliance.

Costs

The alternative proposed would increase the NATO bureaucracy by perhaps as many as two to four thousand permanent staff members. This cost may be viewed by some as excessive. If this alternative is only 50 percent more efficient than the existing system, it would add the equivalent of 15 to 25 percent more combat forces to the 5 million men under arms with a negligible increase in the $140 billion now spent each year on defense.

Conclusion

Organization to achieve NATO standardization is feasible, necessary, and long overdue. Suitable courses of action are reasonably clear. A Weapons Family Manager concept and a NATO Procurement Agency should be initiated promptly.

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Appendix

Standardization Policy of United States

Section 814(a) of the Department of Defense Appropriation Authorization Act, 1976 Relating to Standardization

SECTION 802

Section 814(a) of the Department of Defense Appropriation Authorization Act, 1976 (89 Stat. 544), is amended as follows:

(a) (1) *It is the policy of the United States that equipment procured for the use of personnel of the Armed Forces of the United States stationed in Europe under the terms of North Atlantic Treaty should be standardized or at least interoperable with equipment of other members of the North Atlantic Treaty Organization.* In carrying out such policy the Secretary of Defense shall, to the maximum feasible extent, initiate and carry out procurement procedures that provide for the acquisition of equipment which is standardized or interoperable with equipment of other members of the North Atlantic Treaty Organization whenever such equipment is to be used by personnel of the Armed Forces of the United States stationed in Europe under the terms of the North Atlantic Treaty. Such procedures shall also take into consideration the cost, functions, quality, and availability of the equipment to be procured. In any case in which equipment authorized to be procured under title I of this Act is utilized for the purpose of carrying out the foregoing policy, the Secretary of Defense shall report to Congress the full details of the nature and substance of any and all agreements entered into by the United States with any other member or members of the North Atlantic Treaty Organization providing for the acquisition of equipment manufactured outside the United States in exchange for, or as a part of, any other agreement by such member or members to acquire equipment manufactured in the United States. Such report shall be made by the Secretary within 30 days of the date of enactment of this Act.

(2) Whenever the Secretary of Defense determines that it is necessary in order to carry out the policy expressed in paragraph (1) of this subsection, to procure equipment manufactured outside the United States, he is authorized to determine, for the purposes of section 2 or title III of the Act of March 3, 1933 (47 Stat. 1520; 41 U.S.C. 10a), [Buy American Act] that *the acquisition of such equipment manufactured in the United States is inconsistent with the public interest.*

(3) *In any case in which the Secretary of Defense initiates procurement action on a new major system which is not standard or interoperable with equipment of other members of the North Atlantic Treaty Organization, he shall report that fact to the Congress* in the annual report required under section 302(c) of Public Law 93-365, as amended, including a description of the system to be procured and the reasons for that choice.

SECTION 803

(a) It is the sense of Congress that weapons systems being developed wholly or primarily for employment in the North Atlantic Treaty Organization theater shall conform to a common North Atlantic Treaty Organization requirement in order to proceed toward joint doctrine and planning and to facilitate maximum feasible standardization and interoperability of equipment. A common North Atlantic Treaty Organization requirement shall be understood to include a common definition of the military threat to the North Atlantic Treaty Organization countries. The Secretary of Defense shall, in the reports required by section 302(c) of Public Law 93-365, as amended, identify those programs in research and development for United States forces in Europe and the common North Atlantic Treaty Organization requirements which such programs support. In the absence of such common requirement, the Secretary shall include a discussion of the actions taken within the North Atlantic Alliance in pursuit of a common requirement. *The Secretary of Defense shall also report on efforts to establish a regular procedure and mechanism within the North Atlantic Treaty Organization for determining common military requirements.*

(b) *It is the sense of the Congress that progress toward the realization of the objectives of standardization and interoperability would be enhanced by*

expanded inter-Allied procurement of arms and equipment within the North Atlantic Treaty Organization. *It is further the sense of the Congress that expanded inter-Allied procurement would be facilitated by greater reliance on licensing and co-production agreements* among the signatories of the North Atlantic Treaty. It is the Congress' considered judgment that such agreements, if properly constructed so as to preserve the efficiencies associated with economies of scale, could not only minimize potential economic hardship to parties to such agreements but also increase the survivability, in time of war, of the Alliance's armaments production base by dispersing manufacturing facilities. Accordingly, the Secretary of Defense, in conjunction with appropriate representatives of other members of the Alliance, shall attempt to the maximum extent feasible (1) to identify areas for such cooperative arrangements and (2) to negotiate such agreements pursuant to these ends. The Secretary of Defense shall include in the report to the Congress required by section 302(c) of Public Law 93-365, as amended, a discussion of the specific assessments made under the above provisions and the results achieved with the North Atlantic Treaty Organization allies.

(c) It is the sense of the Congress that standardization of weapons and equipment within the North Atlantic Alliance on the basis of *a "two-way street" concept of cooperation in defense procurement* between Europe and North America *could only work in a realistic sense if the European nations operated on a united and collective basis.* Accordingly, *the Congress encourages the governments of Europe to accelerate their present efforts to achieve European armaments collaboration among all European members of the Alliance.*

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Page 1. First line in article description box should read: "Technological change—growth rate—in technology applications and, the . . ."

Page 34: Column 2, paragraph 2, sentence 2 commencing on line 2 should read: "This includes indorsement and support of the professional staffers of the Armed Services and Appropriations Committees of both the House of Representatives and the Senate."

Page 39: Column 2, paragraph 2, line 1, should read: "The fact that committee staffs do have access . . ."

Page 43: Footnote, should read: "Last public address, April 11, 1865," The quotation referenced should read, "Important principles may, and must, be inflexible."

Page 55: Headline, should read: "DEFENSE SYSTEMS MANAGEMENT REVIEW"