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A FRAMEWORK FOR EVALUATING CANDIDATE FOREIGN WEAPONS SYSTEMS.(U)
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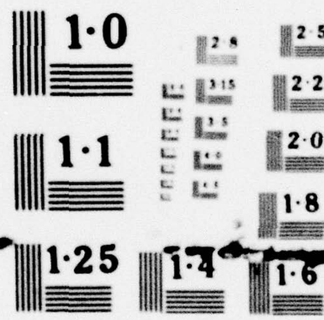

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A FRAMEWORK FOR
EVALUATING CANDIDATE
FOREIGN WEAPONS SYSTEMS

by

Ross Joseph Hieb
Captain, United States Marine Corps

September 1979

Thesis Advisor: David N. Burt

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The Department of Defense (DOD) is under increasing pressure to purchase defense systems and subsystems which have been developed abroad. There are many unique issues to be considered before making a decision to purchase a foreign developed defense system (subsystem). The Congress and GAO have become increasingly critical of DOD's efforts in this area.

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A FRAMEWORK FOR EVALUATING CANDIDATE FOREIGN WEAPONS SYSTEMS

by

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Submitted in partial fulfillment of the requirements for the degree of

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from the

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ABSTRACT

The Department of Defense (DOD) is under increasing pressure to purchase defense systems and subsystems which have been developed abroad. There are many unique issues to be considered before making a decision to purchase a foreign developed defense system (subsystem). The Congress and GAO have become increasingly critical of DOD's efforts in this area.

In this thesis, a conceptual model focusing on four major issue areas, Y_1: Changes in NATO Defense Capability, Y_2: Real U. S. Costs, Y_3: Economic Effects, and Y_4: Political Benefits, is developed to assist DOD personnel in considering, for acquisition, foreign developed systems and subsystems.

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I. INTRODUCTION

A. OVERVIEW

The United States and its NATO allies are attempting to realize a more effective and economical military alliance by implementing a policy of Rationalization/Standardization and Interoperability (R/S&I) regarding weapons development and procurement efforts. As a result of this policy, an era of previously unparalleled effort in the area of cooperative weapons development has evolved. The resulting trade agreements have resulted in a flow of technology and arms that has given rise to the term "Two-Way-Street." This is in reference to the fact that not only is Europe buying technology and arms from the U. S. but that the U. S. is in turn purchasing technology and arms from Europe.

In support of this policy, both the Congress and the Department of Defense (DOD) have passed the appropriate legislation and have made the necessary policy statements to firmly establish the fact that each takes the objectives of R/S&I seriously. Despite all the verbage to the contrary, however, Congress and the DOD are not in full agreement regarding the benefits to be gained by this policy. Nor are they in agreement in regard to the direction or magnitude this effort should assume. Consequently, some of the systems selected by the DOD in support of this policy are being met with a great deal of opposition on Capitol Hill.

1. Research Question

This dilemma provides the basis for the research question of this study: Can a model be developed which, when applied within the current framework of systems acquisition, will satisfy the information needs of Congress and thus assure a reasonable certainty of acquisition approval?

2. The Objective

The objective, therefore, is to determine if such a model may be developed and, if so, to present it as a supplement to the current process. What is needed is a model or framework which, when applied to selecting European systems, draws together the various peripheral considerations of the decision process and which insures that the information needs of all concerned are treated.

3. The Scope

The model should aim at addressing not only the cost effectiveness measures which are accentuated in the current process, but should address the impact of economics and politics as well. It should call upon the experience of as many people as is feasible, not just on the in-house experts. This is particularly necessary if any measure of objectivity is to be obtained.

Also, the model should be useful in application during the entire selection process. That is, it should serve equally in the screening of candidate systems as well as in the recommendation for production. This is necessary to insure that the U. S. is not unwittingly committed to the selection of a system as a result of some off-set agreement or as the result of political expediency.

4. Assumptions

Basic to this model are the assumptions that a clear and definite need, in the form of a Mission Element Needs Statement (MENS), has been approved prior to any candidate being considered. Also, it is assumed that the available information will improve in quality as the process of selection proceeds. Additionally, it is assumed that the reader is familiar with the DSARC process and the Major Systems Acquisition Process as outlined in OMB Circular A-109 and DODINST 5000,1 and 5000,2.

5. Limitations

It must be acknowledged that this study does not enjoy the input of members of the European industrial community since resources and time prohibited their active involvement. Additionally, time and the limited number of MENS so far approved, have not permitted a field test of this study.

6. Organization

In presenting the proposed model for consideration, Chapter One deals with the background of R/S&I. The following chapters will deal, in order, with the methodology, the model, an application, and finally the conclusions and recommendations which arise.

B. KEY DEFINITIONS

Before proceeding any further, a few of the key definitions that will be used throughout this paper should be addressed.

1. R/S&I

The term R/S&I refers to Rationalization/Standardization and Interoperability. These three terms are used to describe an objective which is expected, once realized, to result in a significant increase in the ability of NATO to efficiently defend itself. To more clearly explain the terms, each will be addressed individually.

a. Rationalization

DOD Directive 2010.6, Standardization and Interoperability of Weapon Systems and Equipment Within the North Atlantic Treaty Organization (NATO), 11 Mar 77, states that rationalization is: "Any action that increases the effectiveness of alliance forces through more efficient and effective use of defense resources committed to the alliance." [8:5] It encompasses the two sister terms as well as political and economic issues.

b. Standardization

DOD Directive 2010.6 goes on to define standardization as:

"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 logistics 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." [8:5-6]

c. Interoperability

Again from DOD Directive 2010.6. one finds interoperability defined as: "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." [8:6]

2. Not Invented Here (NIH)

While NIH is not a term which will be used as part of the model, it is important to understand its emotional implications as they pertain to the R/S&I process. In essence, the term refers to any aversion that exists within the military establishment to the use of systems and weapons designed and/or manufactured abroad. For the purpose of this study, this aversion will be assumed to be of minimal concern or impact as was determined in one study which stated that NIH:

"...manifests itself in four major areas of concern: foreign product technology; adequacy of foreign technology;

timeliness of foreign suppliers in meeting shipment schedules and the dependability of foreign sources to meet continuing needs. [1:62]

The study went on to find, however, that for the most part these concerns were ill founded. [1:62]

With respect to quality, the study found, "...that in most cases, these products were equal to or better than some items purchased domestically." [1:63] Likewise, with respect to technology, the study found, "...that modern manufacturing processes, particularly in Europe, were capable of producing selected items that were superior to domestic products." [1:65] Regarding timeliness, the study determined, "...that foreign companies, with proper controls, could be held to the same standards required of U. S. companies." [1:65] Finally, concerning the problem of dependability, the study discovered, "...that foreign sources generally can be depended upon to support their equipment adequately." [1:67]

B. BACKGROUND

In the past, as much by intuition as by design, the DOD has chosen to observe classical location theory when selecting a source for its weapon systems. Accordingly, it has tended to avail itself of sources of supply that were close at hand, namely the U. S. arms industry.

Motivated by the desire to maintain an economically vital arms industry at home and by the demands of strong labor organizations, Congress aided in perpetuating this tendency by passing, on March 3, 1933, the "Buy American Act" which required that those goods purchased for the use of our armed forces be procured from U. S. sources. When this act was passed, however, the results of an as yet unfought World War and the exigencies of the ensuing "Cold War" could not be anticipated.

Following World War II and the ensuing threat posed by the resulting power vacuum in Western Europe and the presence of a militarily superior Soviet Army in Eastern Europe, an initially subtle change in U. S. weapons acquisition policies began to take shape. The vehicle for that change was born with the signing of the North Atlantic Treaty on April 4, 1949.

The treaty was signed by the twelve original signatories in order "...to promote stability and well being in the North Atlantic area" and to, "...unite their efforts for collective defense and for the preservation of peace and security." [3:302]

The particular part (or section) of the Treaty which is of interest in light of R/S&I is Article 3 which states:

> "...the parties, separately and jointly, by means of continuous and effective self help and mutual aid, will maintain and develop their individual and collective capacity to resist armed attack." [3:303]

It is this article, and in particular the words, "collective capacity", which first states the need for reconciliation of military requirements within the NATO alliance. This was interpreted to include the area of arms and equipment. In 1952, the Temporary Council Committee determined that the interest of NATO necessitated:

> "...correlating production programs of major end items of equipment, including aircraft, artillery, small arms, radar and wireless sets, vehicles, ships and various types of ammunition." [3:131]

Though initial efforts were limited, in as much as no master plan was developed, - a weakness which exists to this day - numerous roadblocks and pitfalls existed, such as an early version of the "not invented here" (NIH) syndrome and a reluctance to finance multi-national projects. Additionally, the great disparity in economic and industrial efficiencies between member countries as well as fears of breaches in security made initial efforts less than successful. [3:131]

As long as NATO maintained a technological and economic advantage over the Soviet Union, little impetus existed to press the need for the "collective capacity" called for in the Treaty. Indeed, it was sufficient for each country to develop its armed forces in a manner consistent with its own economies and priorities and with the degree of oversight exercised by the respective legislative body. In essence, the strength of the alliance had permitted, "...placing the economic interests of each independent nation above the interests of a strong and effective alliance." [4:66]

One should not think, however, that progress was not made. In fact standardization was achieved in the specification of various explosives, ammunition, vehicle components, impact tests, ballistics standards and conversion standards as well as aviation fuels and refueling fittings. However, a great deal of this standardization was forced by the fact that the majority of the arms supplied to the NATO countries came from the U. S., since the arms industries in Europe were initially in shambles. Furthermore, a significant part of the funding for rebuilding European arms industry came in the form of grants-in-aid aimed at developing the ability to manufacture spares for the U. S. designed systems then in use.

This arrangement soon proved not to be inviolate, however. Soon, the European arms industry began to supply an increasingly larger proportion of its own arms requirements, and in turn, began to actively develop its own export markets. Accordingly, except in those areas requiring the most advanced technology and large capital investment, Europe began to shun U. S. manufactured weapons in favor of its own products.

To a certain extent, European countries began to resent the dominance of the U. S. arms industry in NATO. As a result, NATO now resembles a conglomeration of disparate parts rather than an efficient and mutually supporting defensive entity. As an example:

> "...there are deployed among the NATO military forces today at least 7 basic models of tanks; 23 types of combat aircraft; over 100 types of tactical missile systems; multiple guns of different caliber and a host of different types of radars --- 36 in NATO's navies alone. Some guns of the same caliber cannot fire the same ammunition; aircraft with diverse ordnance and fuel requirements can only rearm or refuel at certain airfields; and commanders have experienced difficulties in communications because their communication equipment is not compatible." [5:1]

What makes this particularly worrisome is the fact that during this same period the Warsaw Pact, being totally dominated by the Soviet Union, has increasingly standardized its forces to the extent that, except for varying degrees of modernization, each country employs arms which are totally standardized and interoperable with those of the other members of the alliance.

Making this situation even less agreeable is the fact that whereas NATO formerly enjoyed a vast technological superiority to the Warsaw Pact countries, at the present time that advantage is nearly, if not certainly, eroded. As stated by Dr. William Perry:

> "...the Soviet Union and the Warsaw Pact have focused not on independence and consumer goods for their citizens, but on monolithic power building. The Soviets have been spearheading this effort, having increased their defense expenditures at a compound rate of 3 to 4 percent per year for nearly two decades. They have overcome a 10-to-1 inferiority in the central strategic balance, having now reached essential equivalence. [4:66]

Confronted with these realities and with the resulting impetus to bolster the NATO alliance, a new emphasis has been placed on the term "collective capacity" which was initially presented in Article 3 of the original Treaty. The form of this emphasis closely resembles the original task, outlined by those early committees, aimed at promoting, "...the most efficient use of the resources of the Alliance for the equipment and support of its forces." [3:130] This emphasis derives a special significance from the fact that bolstering the NATO Alliance presents an economic burden that threatens to wreak havoc on the consumer economies of the member nations. The U. S., no less than Europe, is feeling the pressure of this demand and accordingly has, in concert with its allies, embarked on a policy of R/S&I.

B. THE PROBLEM

The difficulty faced by the U. S. DOD is that, while it has begun to implement the precepts of the policy of R/S&I, Congress has begun to ask many questions which indicate an atmosphere of confusion regarding how to evaluate candidate weapons systems. It appears that while the DOD is laboring under the concept that R/S&I is a policy to be consistently applied, Congress views it as a policy to be selectively applied.

To demonstrate, Congress added the Culver-Nunn Amendment to the DOD Appropriation Authorization Act for 1977 stating in part:

> "...it is the policy of the U. S. that equipment procured for the use of personnel of the Armed Forces of the United States stationed in Europe *** should be standardized or at least interoperable with equipment of other members of the North Atlantic Treaty Organization." [6:10]

The amendment went on to require that:

> "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." [6:10]

This legislation permitted the Secretary of Defense to waive the "Buy American" Act when he deemed it in the best interest of the national defense.

To this end, the Secretary of Defense presented a report to Congress regarding R/S&I within NATO. He stated:

> "The DOD will vigorously pursue greater compatibility of U. S. and Allied Forces to improve their ability to operate effectively together and, to the extent feasible, achieve more efficient Alliance resource utilization. We will continue to emphasize rationalization/standardization and interoperability including, as appropriate, increased purchases or license of Allied equipment." [2:3]

Despite the legislation and supporting rhetoric, Congress has presented stiff opposition to recent large scale attempts at R/S&I. The most notable of these being the Army's efforts to acquire the Roland Missile System and the 120mm gun for its new XM-1 tank. The form of this opposition strikes at the very rationale for R/S&I, mainly its value to the U. S. and NATO, and is most graphically presented in the findings of the Special Subcommittee on NATO Standardization, Interoperability and Readiness. The committee found that:

> "Obviously arms cooperation is not the total answer to NATO's problems.
>
> The discussion of potential savings is mostly theoretical, however. No witness who appeared before the subcommittee suggested there would be any immediate savings as a result of arms cooperation. As of now, it is impossible to accurately predict whether arms cooperation will save or cost money, either in the near future or in the long run. This is not surprising since there is not even a consensus on how to interpret data on cooperative efforts to date. For example, there is no clear agreement as to whether the "Americanization" of the Roland Missile System has saved or wasted defense dollars." [6:14]

The committee went on to raise the major questions that it felt must be answered regarding R/S&I:

> "What are the economic benefits to be realized, and what costs are acceptable to achieve these benefits? What are the military benefits of implementing this policy? The question of what military benefits are achievable leads to an even broader question about whether immediate military benefit to U. S. Forces should be sacrificed for political solidarity." [6:14]

In response, the Secretary of Defense proposed the following criteria for measuring success in dealing with NATO's problems:

> "Does it cost effectively strengthen NATO's capability to deter or defend against Warsaw Pact attack? Does it enhance or weaken NATO's political solidarity?" [6:15]

This, however, would appear to be a very difficult task that cannot be approached on the basis of some broad wash of the value of R/S&I. Rather, it is an effort which will require constant review in order to accurately reflect the priorities and realities of the time frame in which the matter is being considered. This is true because of the need to justify each candidate at several different stages during both the DSARC and budget processes.

In other words:

> "The question of how the Congress can best provide for all of the defense requirements of the United States has to be answered annually and the lack of any meaningful measure of the benefits and costs of NATO standardization and interoperability complicates the process." [6:15]

General Alexander Haig stated that:

> "...Each of these decisions must be an anguishing and carefully worked out judgement of its own and a generalized formula will get you in trouble. It depends on the pay-off and the deficiency you are filling and how urgent it is in the context of your broad strategic concerns." [6:15]

A complication that exists with the present environment is the fact that often, in the area of off-shore procurement, the U. S. finds itself committed to a system or component as a condition of trade-off agreements or of economic and political concessions made in support of our own Foreign Military Sales Program. For instance, one of the conditions for the sale of the AWACS to the Federal Republic of Germany was the requirement that the U. S. purchase, in return, "the 120mm tank gun, German equipment and labor for installation of a new U. S. European Telephone System, and purchase of German non-tactical vehicles." [6:20]

The danger of such commitments is that the U. S. may find that it must either buy a system that, upon deeper analysis, does not meet its needs or that it may be forced to renege on a commitment. Neither option is particularly attractive to the U. S. or in its best interest. Thus, it would be of great value if there existed a means for timely and relevant screening of the off-set candidates prior to a commitment being made.

With this in mind, DOD must look for more viable approaches than the classical cost effectiveness one when evaluating foreign manufactured systems. The classical approach is inadequate with regard to the information needs of Congress. Also, it is subject to many variables existent in the European arms industry that were not considered when it was formulated. The total spectrum of economics, politics, strategy and military cost effectiveness must be considered and presented by a useful approach.

To be most effective, the approach should lend itself to varying levels of detail as required by the environment in which it is being applied. It should be useful to national representatives or political figures when screening candidate European systems offered in exchange for our own sales abroad.

Thus, it should provide a framework upon which cursory evaluation could be made based upon the values and variables which ultimately will be dealt with in depth. On the other hand, the same approach or model should provide the basis for a more rigorous analysis that accounts not only for the requirements of regulations and quantitative objectives but additionally for the economic and political implications of the acquisition as well. Such a model could satisfy many of the needs of the DSARC and the Congress as well as the needs of the statesman. This reconciliation and coordination by one model could increase the likelihood that the U. S. will pursue those programs and systems that give the most promise of being acceptable. To that end, the remainder of this thesis will be devoted to developing such a model.

II. METHODOLOGY

A. OVERVIEW

There exist numerous instructions which provide the project manager and other decision makers with policy guidance and the mechanics for acquiring weapon systems. These, by establishing milestones at the critical decision junctures and by delineating factors and cost estimating relationships to be considered when evaluating a candidate system, provide some assurance that the final selection accurately reflects the needs of the defense establishment. However, these instructions do not address the political and economic factors of the broadened NATO thrust toward R/S&I.

There is little to suggest that the acquisition procedure, as it now exists, needs to be restructured. Rather, it appears that the process needs to be broadened in order to assure that those factors which are now considered reflect the political and economic realities of the NATO environment. The credibility of the DOD cost estimators is suspect enough when applied to the U. S. environment. Unless Congress can be assured that the selection of a European candidate system, or an alternative to such a candidate, adequately reflects the broadened environment implied, there is little reason to expect Congress to have significant confidence in the choice.

With this in mind, we set out to develop a methodology which might be useful in lending the "objectivity" that various members of GAO and the Congress felt was lacking in the current efforts to procure European weapon systems. In so doing, it was hoped that the tunnel vision which motivates some efforts as well as the "not invented here" syndrome which plagues others, might finally be laid to rest and be replaced with a more logical approach.

B. THE EMPIRICAL APPROACH

The initial effort of this research aimed at developing an estimating relationship from which one could predict the degree of success that might reasonably be expected from a candidate European system. The basic thrust involved identifying as many pertinent variables as possible which, when measured, could lend themselves to a proper regression analysis and ultimately an estimating relationship. As shall be pointed out, however, this proved to be a difficult task.

1. Identifying the Variables

Of primary concern was the assurance that no pertinent variable would go untested. Thus, a brainstorming session was arranged which brought together representatives of the following disciplines: Systems Acquisition, Operations Research, Logistics and Economics. The list of variables which resulted from that session is presented in Appendix A.

As one can readily see, there was no lack of ideas. This reflects the philosophy shared by all present that the effort would benefit more from a surfeit of variables, that might not all prove significant, than from a conservative list that might unwittingly exclude a very valuable item.

While it appeared that many of the variables would indeed prove to be of little significance, a sound basis for proceeding had been established. In fact, as was later reinforced during subsequent interviews at Hughes Aircraft Company, it was felt that to consider a variable and then discard it for cause was a more creditable approach than that of dismissing, out of hand, a variable without due consideration.

2. Identifying the Systems

Having identified a list of potential variables, it remained to identify what systems and subsystems of European design were currently in use in the U. S. Specifically, it was desired that enough systems would be identified in each of several technology categories to provide a sufficiently large sample to be statistically significant.

It soon became apparent, however, that the U. S. has very few operational systems of European design and that those which are in use have accumulated a very limited amount of operational data upon which to make an evaluation. Thus, a problem of quantity arose. Additionally, those systems which have been adopted are very diverse in nature and, in a few instances, are so unique as to defy comparison.

a. The Problem of Quantity

While a plethora of projects are underway which suggest a potential for a more significant presence of European technology within the U. S. inventory, at present that presence is very small. For instance, the only systems or subsystems presently fully operational, on a significant scale, are the British made Harrier V/STOL jet, the Italian Oto Molera (Mk-75, 76mm gun), the Mk-92 Fire Control System (FCS) designed by SIGNAAL of the Netherlands, the 105mm tank gun presently installed on the U. S. M60 series tanks, numerous models of the British Martin ejection seat, and the Belgian made MAG-58 machine gun.

While the raw quantity would be sufficient for the purpose of a regression analysis, one could hardly say that the systems involved display sufficient technological commonality, in any respect, to be useful in providing an estimating relationship for future systems of any specific nature. Additionally, of those systems which do possess sufficient operational data from which to make an evaluation, specifically the Harrier, the 105mm gun, the Mk-75 gun and the Mk-92 FCS, all have been so heavily "Americanized" during U. S. licensed production or retrofit as to render any such evaluation suspect. This is particularly true with regard to such variables as state-of-the-art, reliability, quality control and production standards.

b. The Problem of Comparison

Aside from the lack of sufficient operational data, there is the problem of finding suitable U. S. systems against which to compare many of the above European systems. This lack of comparability is not surprising. Upon close examination one observes that it is often the very unique nature of the European systems and subsystems which has resulted in their purchase in the first place.

In the case of the Harrier, an aircraft which followed an evolutionary R&D effort unlike that of any other airplane in the world and one which demonstrates very unique flight characteristics, the U. S. gained an operational system, free of any significant R&D investment, with which to test and evaluate an operational capability. This opportunity presented itself despite the fact that no such system existed in the U. S.

As was determined by the Senate Subcommittee on Close Air Support during hearings to evaluate the validity of the concurrent development of the Air Force's A-X (A-10), the Army's Cheyenne helicopter and procurement of the Harrier (AV-8A):

> "There does not appear to the subcommittee to be a valid issue of duplication between the Harrier and the A-X fixed wing aircraft. The subcommittee sees the Harrier program as primarily an experiment to evaluate the operational utility of V/STOL fixed wing aircraft ..... The Harrier program does offer the chance to obtain true operational experience with VTOL squadrons. In view of the emphasis being placed on future VTOL aircraft in the Navy, with its air-capable ship concept, as well as in the Marines for close support attack aircraft, the subcommittee recommends that the Harriers procured be used to evaluate these concepts of operation." [7:25-26]

Similarly, the Oto Molera gun is a unique candidate which provides an operational capability, if not a new technology, not currently available in the U. S. and one which otherwise would have required a significant investment in design and start-up costs. As was indicated during interviews with NATO PHM Ship Acquisition Project personnel and with Oto Molera Project personnel, the gun, as well as the Mk-92 FCS, represent an evolutionary development of weapons systems suitable for use on small coastal and medium range patrol craft.

This area of interest had long lain dormant in the U. S. due to its emphasis on a "blue water" Navy and its globe skirting ships capable of mounting large bore guns with their scaled up fire control systems. To institute a design effort aimed at filling the need for more compact systems suitable for craft such as the PHM and FFG-7 class ships would have required a significant investment by DOD.

As for the Martin Baker ejection seats, they represent a tradition which is almost proprietary in nature and has only recently been tentatively challenged by U. S. aerospace firms. Therefore, there is little of U. S. design or manufacture against which to compare the seats.

To emphasize that the role of uniqueness is not peculiar to the military acquisition process, one need only observe some of the major acquisitions made by the civilian industry. For instance, the purchase of the A-300 Airbus by Eastern airlines acknowledges not only a very attractive financial arrangement offered by Airbus Industries but the fact that, as yet, medium range wide body jets are only just entering the prototype stage in the U. S. aerospace industry. Also Foss Tug's choice of the Motoren-und Turbinen-Union (MTU) marine engine for its new tug boats reflects the fact that the majority of the U. S. marine engines are heavy marinized land engines which do not produce anywhere near the horsepower to weight ratio of European marine diesels.

C. A CHANGE OF DIRECTION

It became apparent then that little existed in the way of classifiable and comparative data from which to collect sufficient information to perform a neat and sanitary regression analysis such as was envisioned. There does not exist at this time sufficient quantity or depth of systems in the U. S. to provide the correlation necessary to develop any manner of reliable or even statistically significant estimating relationship.

Being aware that this conclusion in no way diminished the fact that a problem still exists and being convinced that there is always more than one way to approach a problem, a search began for a new tack.

As was indicated earlier, while Congress has not opposed the principle of R/S&I, it has questioned the concept and has taken aim at several individual weapons such as the 120mm gun and Roland on the basis of economic, political and military value. As one study indicated:

> "The Congress has taken collective action in support of NATO standardization and interoperability. However, they still may resist individual purchases for a variety of reasons. The primary reasons usually relate to protection of U. S. industry and to whether the purchase is in the best interests of the U. S. militarily." [8:2]

Having failed to develop an empirically predictive model, the effort seemed logically to focus on developing a conceptual model that would provide a framework for addressing those areas of impact which are of the most concern to the Department of Defense and the Congress, namely military, economic and political. The model that was formulated consisted of fourteen variables. It is presented in Appendix B. These fourteen variables represent those items which experience, reading and research suggested were the more significant of the variables currently considered as well as those which were most often responsible for Congressional skepticism regarding candidate European systems. Once they were identified, another brainstorming session, representing the disciplines noted earlier, was organized to discuss and refine the variables. As a result of this session, the following grouping of four broad conceptual categories or issue areas was identified:

Y_1: CHANGES IN NATO DEFENSE CAPABILITY

Y_2: REAL U. S. COSTS

Y_3: ECONOMIC EFFECTS

Y_4: POLITICAL BENEFITS

Several variables were combined or deleted while two additional variables, Operating Costs and Royalties, were added. This model was then presented to Dr. Ellen Frost, Deputy Assistant Secretary for International Economic Affairs, and to Dr. Stewart Blakely, formerly of Stanford Research Institute, and an international authority on R&D management. Next, it was presented to Dr. Leonard Grosse and Dr. Howard Laitin of Hughes Aircraft, Dr. Reiner Huber, Professor of Applied Systems Science in the Computer Science Department of the Hochschule der Bunderswher München, and to members of the systems acquisition staff of GAO for critique and comment. Their recommendations and insights led to the final form of the model as presented in Chapter III.

III. THE MODEL

A. OVERVIEW

As indicated in the previous chapter, the model represents several iterations and one false start. Thus, it is one which has evolved from a great deal of thought and research. As such, it represents not only a methodology but a perspective of what are the broader vital issues to be considered when evaluating a system or component of European manufacture or design.

The model addresses the concern raised by Congressman Frank Horton (Rep N. Y.) when he stated:

> "In short, we must be ready to answer the political and economic questions that can be expected when we purchase a European weapon system for an American system. We must likewise be willing to deal with the military questions that can be expected when we buy a European system instead of a possibly superior American system." [9:3]

In this respect, the model addresses four main issue areas. It provides a logical framework for identifying and addressing the relevant issues that should be addressed prior to any initial statements of intent. Also, these same issue areas, when analyzed more rigorously as better estimates become available, provide the framework required to anticipate the information requirements of the later stages of the DSARC process and of the Congressional review process.

It is intended that by consistently applying this framework, albeit with varying degrees of intensity and thoroughness, in concert with existing regulations, one can reasonably expect that the issues of R/S&I can be successfully resolved during the acquisition process. In addition, it is intended that this model will provide a degree of "objectivity" which presently is lacking due to the narrow scope of present procedures and to emotions of the NIH Syndrome which now permeate the decision environment.

B. ASSUMPTIONS

It should be noted at this point that the model does not address the determination of performance characteristics. It assumes that these are known or have been estimated. Rather, the model addresses those items of environment which, as has been indicated, may weigh heavily on the decision process.

Finally, the model is designed to consider each variable exclusive of the others. That is, no variable has an element in common with any other variable. And, in all instances, the model presumes a present value analysis of all costs and benefits.

C. THE STRUCTURE

Exhibit 1 and the following sections present each variable of the model in depth and explains how each is applied, whether used during the screening process or during the latter stages of the decision cycle. Two hypothetical applications are described in Chapter IV. At Milestone 0 of the DSARC process a scalar value will be assigned. Later in the acquisition cycle, monetary costs (benefits) can be assigned to many of the variables.

The assignment of scalar values will require that the decision maker determine the scale to be used, i.e. one-to-five (1-5), one-to-ten (1-10) or even zero-to-one thousand (0-1000). The scale chosen will depend on the degree of precision available and on the confidence the decision maker has in his ability to meaningfully assign these values. The spread between the assigned values for competing systems for a particular variable are of more significance than the values themselves. The scalar values are not designed to be additive.

EXHIBIT 1

Value/Cost = f (Y_1, Y_2, Y_3, Y_4)

Where Y_1 = Changes in NATO defense capability

and Y_1 = f (X_1, X_2, X_3, X_4)

Where X_1 = Effectiveness

X_2 = Timeliness of availability

X_3 = Aggregate defense systems vulnerability

X_4 = Integration at battlefield level

Where Y_2 = Real U. S. costs

and Y_2 = f (X_5, X_6, X_7, X_8, X_9, X_{10})

Where X_5 = Development value/cost

X_6 = Production value/cost

X_7 = Force logistics value/cost

X_8 = Data transfer value/cost

X_9 = Operational value/cost

X_{10} = Royalty value/cost

Where Y_3 = Economic effects

and Y_3 = f (X_{11}, X_{12}, X_{13})

Where X_{11} = Value/cost of export sales

X_{12} = Value/cost of off-sets

X_{13} = Balance of payments value/cost

X_{14} = Effect on U. S. labor force

Where Y_4 = Political benefits

1. $\underline{Y_1}$: Changes in NATO Defense Capability:

The first of four issue areas is intended to measure the effect the selection of a candidate weapon system will have on the ability of NATO (including the U. S.) to defend itself from attack. The issue area is divided into four sub-variables which together account for the major considerations affecting this capability. Due to difficulties in estimating these areas in monetary terms at any phase of the acquisition process, scalar values will be used throughout for variables X_1 through X_4.

a. X_1 = Effectiveness:

This variable is intended to estimate the effectiveness of the system based on its ability to perform some mission as defined by the MENS.

b. X_2 = Timeliness of Availability:

This variable will be assigned a scalar value, which represents the estimated defense capability (gain or loss) that will be realized due to the system being available earlier or later than the time frame established by the MENS.

c. X_3 = Aggregate Defense Systems Vulnerability:

This variable is intended to estimate the change in vulnerability in aggregate defense capability resulting from the duplicative/non-duplicative result of adoption of the system. For example, three somewhat duplicative systems, such as the Multi-Role Combat Aircraft (MRCA), the F-15 and the F-16 present the enemy with a broader band of performance capabilities to counter than would deployment of any one of these systems. Thus, selection of any one or two systems would increase aggregate defense systems vulnerability, resulting in a relatively low value for this variable.

d. X_4 = Integration at Battlefield Level:

Estimate the suitability of the candidate to the battlefield commander, considering interface problems such as Command, Control and Communications (C^3).

2. Y_2: Real U. S. Costs

The second of the four issue areas is intended to provide the decision maker with a basis for comparing what real (out of pocket) costs will be incurred by the U. S. as a result of purchasing competing systems. This issue area is subdivided into six sub-variables. Scalar values will be assigned at Milestone 0 while monetary costs may be used later.

a. X_5 = Development Value/Cost:

This variable is aimed at estimating or evaluating the value/cost that will be realized in the R&D community as a result of selecting a particular candidate. If the selection results in the potential for reallocating R&D monies or for reducing the R&D budget, a net savings results. At Milestone 0, this would result in a high (favorable) value, while at Milestone II, for example, a negative monetary cost (i.e., a savings) would result.

b. X_6 = Production Value/Cost:

This variable aims at estimating program production costs as a result of the decision to acquire one or another candidate. It presumes that learning curves and rates of expenditures are taken into consideration.

c. X_7 = Force Logistics Value/Cost:

This variable assigns a value or a cost to the estimated support requirement required for all units of the candidate system. It is appropriate to consider any and all of the items of Life Cycle Costs that fall under the heading of Support.

d. X_8 = Data Transfer Value/Cost:

During the screening process, an attempt will be made to determine if data transfer costs will exist. During later review (e.g., Milestone II), an attempt will be made to determine what these costs will be.

e. X_9 = Operational Value/Cost:

This variable assigns a value or a cost to the estimated operational requirements of the candidate. It is appropriate to consider any and all of the items of Life Cycle Costs that fall under the heading of Operational Costs.

f. X_{10} = Royalty Value/Cost:

During the screening process, it is necessary only to determine if licensing or royalty costs will be incurred. In the later stages of the decision process, however, it will be necessary to estimate what those costs will be.

3. Y_3: Economic Effects

a. X_{11} = Export Sales Value/Cost:

During the screening process, an attempt will be made to determine if any export potential exists with each candidate offered. During the later review process, an attempt will be made to estimate what this potential is in dollars. Any gain in exports will be treated as a benefit (large scalar value) or negative monetary cost.

b. X_{12} = Off-Sets Value/Cost:

An attempt will be made to determine if the candidate has a potential for satisfying any off-set obligations of the U. S. During the screening process, a scalar value will be assigned accordingly. In later reviews, a monetary estimate of the benefit of such an off-set may be made and assigned.

c. X_{13} = Balance of Payments Value/Cost:

An attempt will be made to assess the potential effect on the U. S. balance of payments deficit. A value will be placed on this estimated impact for the screening process, while a dollar estimate will be made upon later review.

d. X_{14} = Effect on U. S. Labor Force:

Each candidate should be evaluated in light of the job impact its selection will have on the labor force as a whole. In later stages, this may be evaluated in terms of the dollar impact the decision has on the economy.

4. Y_4: Political Benefits

Whether using the model as a screen or as a basis for broadening the decision process during the latter stages of the DSARC cycle, this variable will emphasize the role that political priorities play in the ultimate decision and selection. In neither case will a value be assigned to the political benefits. Rather the realities of current priorities will be considered and the opinions of cognizant members of the DOD and the Armed Services Committees will be considered.

It now remains to utilize this framework to aid in the decision process and to supplement the processes now in use. The following chapter will apply the model to both the screening process and the later DSARC processes involved with the decision to produce and deploy the system.

IV. APPLICATION

A. OVERVIEW

As has been indicated, the degree of rigor which will be applied when using the model will be a function of the magnitude and complexity of the system or program which is under consideration. Additionally, it will reflect the environment in which the model is applied. That is, the model will require a great deal more research and rigor to meet the needs of DSARC II or III than would be the case when being utilized as a screen at the DSARC 0 or I level.

To provide an example of how this would be done in each environment, two sample systems will be evaluated and then compared to one another. In the first instance, an example of how the model would be applied as a screen will be addressed, while in the second, the rigor needed to satisfy later DSARC and Congressional requirements will be presented.

It is appropriate to remind the reader that in actual application, the model assumes that a MENS has been accepted which makes evaluation of the candidates a valid exercise. It is not the function of the model to establish the need for a system. Nor is it the function of the model to determine the performance characteristics of the candidates. Rather, the model applies known or estimated performance factors in determining the impact they will have on the given issue area and variables. Also, it is important to remember that each variable is exclusive with regard to the other variables in the model in that no part of what is being estimated by one variable is included in what is being estimated by another.

While the U. S. is not currently actively participating in the evaluations presented, the possibility of such an evaluation is not at all remote. All that is lacking to make the following scenario a reality is the need for an approved MENS.

B. THE BATTLEFIELD SURVEILLANCE SYSTEM

For the sake of discussion, assume that two systems are being considered as candidates for a new battlefield surveillance system. One of these is a satellite system of U. S. design and manufacture while the other, a rotary wing remotely piloted vehicle (RPV), is of European design and is offered for licensed co-production in the U. S.

Those tasked with screening the proposed systems for possible development would need to perform a certain amount of preparatory research to aid them in their contacts with the respective contractors as well as, in the case of the NATO ally, the host government. The depth of this research would depend on the amount of time and information available and on the degree of definition and precision available from the contractors during this phase.

It is likely that the systems would be lacking sufficient definition to permit budget caliber estimates. Thus, it is anticipated that the values assigned each candidate, that is, to each variable, will be scalar in nature rather than monetary. These values will be derived from past experience with similar systems, export opinion, and whenever possible, manufacturer's data or estimates.

The values assigned will be relative in nature and will range from a low value of one (1) to a high value of ten (10). Each candidate will be evaluated on its own merit and ability to satisfy the MENS. Once this has been done, a comparison of the candidates may be performed in a manner similar to the following example:

Spread	Rating
1-2	Marginally Better
3-5	Better
6-8	Superior
9-10	Exceedingly Superior

The reader will remember from the previous chapter that the model consists of four main issue areas, each of which may consist of several variables. As the following example will demonstrate, each of these variables will be assigned an estimated value which can be, in turn, used to compare the candidates to one another.

1. <u>The example</u>

Y_1: Changes in NATO Defense Capability:

X_1 = Effectiveness:

Compare the known or estimated performance capabilities of each system with regard to required mission capability.

The evaluation may estimate that the satellite rates a value of (7) while the RPV rates a value of (8).

The RPV is marginally better than the satellite.

X_2 = Timeliness of Availability:

Evaluate the estimated time to Initial Operational Capability (IOC) of the two candidates and estimate the effect on defense capability benefit/loss.

Assuming that the design and production of a satellite system may require all of an allocated five year time frame, it may rate a value of (5).

The RPV on the other hand, may require only three years to field and be awarded a value of (8).

The RPV is more attractive (better) than the satellite in this area.

X_3 = Aggregate Defense Systems Vulnerability:

Estimate the change in vulnerability of the aggregate defense capability resulting from selection of the candidate.

Since the aggregate defense capability resulting from selection of the satellite will be very hard for the enemy to counter, it may be assigned a high value of (10).

The aggregate defense capability resulting from adoption of the RPV is determined to be fairly easily countered. Thus, the RPV is awarded a value of (4).

The satellite is better than the RPV.

X_4 = Integration:

Estimate the suitability of the candidate to the battlefield commander, considering interface problems, such as Command, Control and Communications.

The satellite is estimated to impose no burden on existing systems. It is awarded a value of (10).

It is anticipated that the RPV will place an increased interface load on existing systems or improvements in order to obtain the required reconnaissance information. It is awarded a value of (3).

The satellite is superior to the RPV.

Y_2: Real U. S. Costs:

X_5 = Development Value:

Estimate the value of each candidate in relation to the resulting efficiency of the U. S. R&D effort.

It may be estimated that developing the satellite will require that the R&D budget be increased or that funds be reallocated from current programs. A value of (5) is awarded.

Acquisition of the RPV will require no increase in the R&D budget and will provide the additional benefit of permitting current RPV and satellite efforts to be channeled into more lucrative areas. Thus, a value of (10) is awarded.

The RPV is better than the satellite.

X_6: Production Value:

Assign a value to each candidate with regard to the estimated total production program cost of each.

A significant front end investment will be required for the satellite which will result in funding shortfalls for other systems or the need to significantly increase the budget. A value of (3) is awarded.

X_6 = Production Value (cont)

The front end cost of the RPV is very low.

A value of (10) is awarded to the RPV candidate.

The RPV is superior in this area.

X_7 = Logistics Value:

Relative to the estimated support costs, what is the value of each candidate?

It is estimated that support costs for the satellite will be very low since no on-system maintenance is required. It is awarded a value of (9).

The RPV will require a large amount of on-system maintenance which will result in fairly high support costs. A value of (3) is awarded.

The satellite is superior to the RPV.

X_8 = Data Transfer Value:

Assign a value to each candidate based on the estimated complexity of any technology transfer efforts and the resulting cost.

The satellite will have no data transfer cost. A maximum value of (10) is awarded.

The RPV will require significant data transfer efforts. It is awarded a value of (4).

The satellite is superior to the RPV.

X_9 = Operational Value:

Award a value based on the estimated cost of operating the candidate.

Operational costs for the satellite will be confined to the cost of assigning an additional communicator to the appropriate echelon of command. A value of (10) is awarded.

X_9 = Operational Value (cont)

Operational costs for the RPV will reflect the need for numerous operators and maintainers.

Therefore, a value of (2) is awarded.

The satellite is superior to the RPV.

X_{10} = Royalty Value:

What is the value of the candidate based on the estimated license and royalty costs that will be incurred?

The satellite will have several sub-systems which will be directly purchased from Europe which entail no royalty costs. A value of (10) is awarded.

The RPV will incur royalty costs as a result of licensed coproduction in the U. S. They are not significant, however. A value of (8) is awarded.

The satellite is marginally better than the RPV.

Y_3: Economic Effects:

X_{11} = U. S. Export Sales Value:

What is the value of the export potential the candidate represents?

The satellite is expected to have little, if any, export potential. A value of (1) is awarded.

The RPV is expected to generate a large third country export potential. A value of (10) is awarded.

The RPV is exceptionally superior to the satellite.

X_{12} = Off-sets Value:

What is the value of each candidate in light of U. S. off-set obligations?

X_{12} = Off-sets Value (cont)

The satellite will satisfy no off-set obligations. A value of (1) is awarded.

The RPV will satisfy a large off-set obligation. A value of (10) is awarded.

The RPV is exceptionally superior to the satellite.

X_{13} = Balance of Payments Value:

What is the value of each candidate in regard to the U. S. balance of payments?

The satellite will generate an outflow of dollars associated with the sub-system procurement and will generate no export potential. The resulting deficit increase merits a value of (4).

The RPV will generate an outflow associated with the licensing costs. A value of (1) is awarded.

The satellite is better than the RPV.

X_{14} = U. S. Labor Force Value:

What is the value of each candidate to the U. S. labor force?

The satellite is not expected to generate any significant increase in jobs in the aerospace industry due to the small numbers required and due to the existing excess capacity in the industry. A value of (3) is awarded.

Due to the numbers that are required, the RPV is expected to generate an increase in labor requirements. A value of (9) is awarded.

The RPV is superior to the satellite.

Y_4: Political Benefits:

The values assigned in regard to political benefits are elusive and vary with the priorities

Y_4: Political Benefits (cont)

of the moment. They must be considered, however. The appropriate members of DOD or of the Armed Services Committees should be polled.

The "political normative override" will come into play at this point.

2. The Comparison

It is of extreme importance that the evaluator be aware that in making the comparison that is now warranted, no attempt should be made to total the values assigned to the candidate in the many variable areas. Since each issue area and each variable impact differently on the decision because of their relative importance, they are not additive in nature. Any attempt to total the values will negate the fact that a rating of "superior" in one area may well be overshadowed by a rating of "better" in a more important area. Rather, the evaluator should only compare the ratings for the candidate systems by variable.

To facilitate the comparison, the following array of value bands is presented in Exhibit 2.

EXHIBIT 2

		SATELLITE	RPV	
Y_1:	X_1		M. B.	(Effectiveness Value)
	X_2		B.	(Timeliness of Availability Value)
	X_3	S.		(Vulnerability Value)
	X_4	B.		(Capability Value)
Y_2:	X_5		B.	(Development Value)
	X_6		S.	(Production Value)
	X_7	S.		(Logistics Value)
	X_8	S.		(Data Transfer Value)
	X_9	S.		(Operational Value)
	X_{10}	M. B.		(Royalty Value)
Y_3:	X_{11}		E. S.	(Export Value)
	X_{12}		E. S.	(Off-set Value)
	X_{13}	B.		(BOP Value)
	X_{14}		S.	(Labor Value)

Y_4: The "political normative override"

Key		
	M. B.	Marginally Better
	B.	Better
	S.	Superior
	E. S.	Exceptionally Superior

C. THE ASW AIRCRAFT

Having examined how the model might be applied as a screen, it now remains to view the model as it might be applied at Milestone II and subsequent reviews. It is at this point that the major effort must be applied when using the model and that the information needs of the reviewing bodies must be fully anticipated. Therefore, the rigor and precision required and sought understandably will be more substantial.

For this example, the model will be applied to evaluate two candidates offered to meet the need for a new Anti-Submarine Warfare (ASW) aircraft. One will be a jet propelled replacement for the P-3C Orion airplane while the other will be a technologically advanced airship of European design.

The projected airplane will have a cruise speed of 425 knots, a payload of 150,000 pounds, an on-station time of 5 hours and a mission radius of 900 miles. The proposed airship will be designed to fly 100 knots, carry a payload of 270,000 pounds, remain on-station for up to 500 hours and have a 2,500 mile mission radius.

It is anticipated that a great deal more definition and estimating precision will be available at this point than at Mileston 0. Thus, well established Life Cycle Cost models and empirically derived Cost Estimating Relationships (CER) will be useful to provide budget caliber estimates and appropriate monetary values.

To preclude clouding the example by using spurious dollar values, monetary units will be assigned in each case. The reader will recognize that the appropriate dollar values would apply in the following example.

1. The Example

Y_1: Changes in NATO Defense Capability:

X_1 = Effectiveness:

The effectiveness of the airplane compared with the MENS results in award of a (6).

The airship is awarded an (8) in this area.

X_2 = Timeliness of Availability:

The airplane is estimated to be operational prior to the maximum allowed time and is awarded a (9).

Due to the fact that some rather innovative design changes to the classic model are necessary, it is estimated the airship will require all of the allotted time resulting in an award of a (3).

X_3 = Aggregate Defense System Vulnerability:

The aggregate defense vulnerability resulting from retention of fixed wing aircraft is not significantly altered. Awarded a (5).

The airship is considered fairly vulnerable to attack.

Aggregate defense vulnerability is increased. Awarded a (2)

X_4 = Integration Suitability:

Each system will be able to operate within the existing system. Each is awarded a (6).

Y_2: Real U. S. Costs:

X_5 = Development Costs:

What is the dollar impact each candidate will have on the efficiency of the U. S. R&D effort?

It is estimated that the airplane will require an increase or reallocation of 10 monetary units in the R&D budget.

The airship will require no increase in current R&D budget. Additionally, the experience gained would have cost 5 monetary units in the U. S. R&D budget. This is recognized as a net savings of 5 monetary units. (-5)

X_6 = Production Cost:

Estimate the program production cost of each candidate.

It is estimated that the airplane will have a cumulative average cost of 10 monetary units per plane. This represents a cost of 1000 monetary units.

The airship is estimated to have a cumulative average cost of 11 monetary units each for a cost of 935 monetary units for 85 airships.

X_7 = Force Logistics Costs:

What are the estimated support costs of each candidate?

The present value Life Cycle Support Cost of the airplane is estimated at 10,000 monetary units.

The airship will have an estimated Life Cycle Support Cost estimated at 5,000 monetary units.

X_8 = Data Transfer Costs:

What are the estimated data transfer costs?

X_8 = Data Transfer Costs (cont)

There will be no data transfer costs for the airplane.

The airship will require a data transfer expenditure of 20 monetary units.

X_9 = Operational Costs:

What are the estimated operational LCC's for each candidate?

It is estimated that the present value operational LCC of the airplane will be 7,000 monetary units.

The airship is estimated to have a present value operational LCC of 4,000 monetary units.

X_{10} = Royalty Costs:

What are the royalty costs associated with each candidate?

There will be none for the airplane.

The propulsion and stabilization system of the airship will be licensed for production in the U. S. and will incur a royalty cost of 5 monetary units.

Y_3: Economic Effects:

X_{11} = Effect on U. S. Export Sales:

What is the cost effect of each candidate's export potential?

The airplane is estimated to have the potential to generate 500 monetary units in export credits. This represents a savings of 500 monetary units. (-500)

The airship will likewise generate third country sales. However, it will be in competition with the designing country resulting in estimated export credits of 300 monetary units. (-300)

X_{12} = Effect on U. S. Off-sets:

What costs are associated with either candidate's potential for satisfying U. S. off-set obligations?

The airplane will not satisfy any off-set obligations.

The airship will satisfy 50 monetary units of off-set obligations for a net savings. (-50)

X_{13} = Effect on Balance of Payments:

What effect will each candidate have on the U. S. balance of payments?

There will be no net increase in the BOP deficit due to acquiring the airplane.

The airship will generate a 15 monetary unit increase in the BOP deficit.

X_{14} = Effect on U. S. Labor Force:

What is the monetary effect of either candidate on the labor force?

Development of the airplane will demand only a 10 percent increase in the use of present production capacity for a net contribution of 6 monetary units. (-6)

Development of the airship will result in the need for an entirely unique production capability which will generate a 20 percent increase in production capacity for a net contribution of 10 monetary units. (-10)

Y_4: Political Benefits:

No monetary value can be placed on political benefits. It will remain to apply the political evaluation during the sensitivity analysis.

What would be of value at this point is an estimate of what range of cost differences might meet with indifference in the political arena.

2. The Comparison

With the above estimates in hand, it only remains to perform a sensitivity analysis to determine which of the candidates is more attractive. Here again the tendency is to sum the values in order to obtain a total cost figure for each of the candidates. The ability to do so is somewhat clouded since the relative importance of the variables in the aggregate is not clear. It also is not clear if the costs or values associated with each of the issue areas are the same in nature since in one case the cost may represent "out of pocket" costs, while in the other, it may represent an opportunity cost. Whatever the inclination of the evaluators, a great deal of caution must be exercised when summing the costs. For this comparison, Y_2 and Y_3 will be summed and Y_1 and Y_4 will be assumed to play a weighting role in the comparison.

Again, an array will be constructed to facilitate the comparison. Refer to Exhibit 3.

EXHIBIT 3

		AIRPLANE	AIRSHIP	
Y_1:	X_1		Better	(Effectiveness)
	X_2	Superior		(Availability Cost)
	X_3	Better		(Vulnerability Cost)
	X_4	Equal	Equal	(Capability Cost)
Y_2:	X_5	10	-5	(Development Cost)
	X_6	1000	935	(Production Cost)
	X_7	10000	5000	(Logistics Cost)
	X_8	0	20	(Data Transfer Cost)
	X_9	7000	4000	(Operational Cost)
	X_{10}	0	5	(Royalty Cost)
		18010	9955	
Y_3:	X_{11}	-500	-300	(Export Cost)
	X_{12}	0	-50	(Off-set cost)
	X_{13}	0	15	(BOP Cost)
	X_{14}	-6	-10	(Labor Cost)
		-506	-345	

Y_4: The "political normative override"

As can be seen, a basis for comparison is established. It will be left to the reader to perform such a comparison since the decision may vary significantly depending on the significance placed on each of the many variables. For instance, it is not clear if the higher cost associated with the airplane in area Y_3 is significant when viewed in the light of the generally better rating the plane received in Y_1. Likewise, political realities may be of such significance that the spread of values in each variable area is not of sufficient magnitude to change a politically motivated choice.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The time has long since past when the U. S. can consider itself the undisputed purveyor to the arsenals of the free world. The realities of fiscal constraint and resource limitations, coupled with the emergence of a technically advanced and efficient European arms industry dictate that the U. S. must increasingly participate in, and foster, an environment which embraces the "two-way street."

Likewise, those same realities necessitate an ever growing environment of cooperation and coordination among the NATO allies. Increasingly, these allies must strive for a commonality of means as well as purpose if the capability of the alliance is to remain more than just a paper tiger.

The concept of R/S&I appears to have met with a concensus in theory, if not in practice. As is the case with any useful theory, it is the final hurdle, implementation, which generally proves to be the more difficult obstacle.

In the U. S., the hurdle of implementation resists being consistently cleared not because of any lingering sense of nationalism, not because of a "not invented here" bias, and not because of any serious fear of industrial competition. Rather, it resists total acceptance because of too little definition and too much emotion.

Congress wants to be assured that DOD is not taking too narrow a view of R/S&I. Of particular concern is the view that. "International arms cooperation encompasses political and economic considerations beyond the jurisdiction of the Department of Defense alone." [6:2] This leads to the conclusion that a broadened evaluative model is required that encompasses the economic and political factors in addition to those of military effectiveness.

For this to be accomplished, however, one must first accept that the R/S&I environment in which the U. S. must compete is exceedingly more diverse than the one DOD currently functions in and is subject to a broadened and more elusive set of variables. These variables must be taken into account when making the acquisition decision.

The model developed in Chapter III is submitted as a point of departure, at the very least. It attempts to lend the objectivity, the focus and the broadened perspective necessary to perform a valid analysis of competing candidates from throughout the NATO community. By applying it in conjunction with current evaluative procedures, it is expected that the DOD and Congress will experience few instances of disagreement regarding the specific systems chosen in support of the R/S&I concept.

There are those who would say that all one need do is reverse the procedures recommended to U. S. allies when they procure arms under the Foreign Military Sales

Program. This procedure would perhaps serve well in successfully supporting a system once purchased. However, it totally ignores the more basic problems of economics and politics.

It is concluded that in order to avail itself of any potential benefits of the "two-way street" approach to R/S&I, the U. S. must realize that the task is not an easy one. The DOD will have to do its homework and will have to insure that only those candidates which, in addition to their military value, offer the greatest benefit economically and politically will be nominated for acquisition. Only then can one reasonably expect that a consistent application and a concensus of objective between DOD and Congress can be achieved regarding R/S&I.

To that end, the model is presented as a framework within which to work. It is not immutable in its form, nor is it all encompassing. It is recognized that the variables may well change to reflect the nature and form of the different candidates to which it may well be applied in the future. None the less, the four major Issue Areas of the model should provide the basic framework for the majority of the possible candidates. Likewise, the variables presented are expected to change more significantly with regard to their weighing than their form.

B. RECOMMENDATIONS

First, it is recommended that this model be used as a check list in evaluating European developed candidates for U. S. acquisition.

Second, it is recommended that evaluation/rating techniques acceptable to the various government agencies involved in the acquisition process (e.g. DOD, Congress, State Department, Treasury, Labor, etc) be developed.

Finally, it is recommended that a body of experts be identified which possesses the necessary information and expertise to rate candidates for the various variables.

APPENDIX A

RECOMMENDED VARIABLES FOR CONSIDERING OFF-SHORE TECHNOLOGY CANDIDATES

A. ALTERNATIVES

1. U. S. Candidates
2. U. S. Design - Foreign Produced
3. Foreign Design - U. S. Produced
4. Foreign design - Foreign Produced

B. LIFE CYCLE COSTS

C. SECURITY/POLITICAL FACTORS

1. Proliferation Safeguards
2. Government Stability
3. Government Involvement
4. Supply Reliability
5. Off-set Agreements

D. STATE-OF-THE-ART

1. Availability in U. S. Industry
2. Technical Competency of Manufacturer
3. Technology Risk
4. Product Technology

E. SYSTEM/COMPLEXITY CHARACTERISTICS

1. System/Sub-assembly
2. SICC
   a. Electronic
   b. Mechanical
   c. Aeronautical
   d. Maritime

F. TECHNOLOGY TRANSFER CONSIDERATIONS

1. Impediments
   a. Language
   b. Bias (user)
2. Channels
   a. Liaison Teams
   b. Sight Surveys

G. RESOURCE SAVINGS

1. R&D
2. Testing
3. Operational Testing

H. SIMILARITY OF MAINTENANCE STRUCTURE

1. Maintenance Echelon
2. Skill Differences

I. DIFFERENCES IN DESIGN AND TEST STANDARDS

J. SYSTEM MATURITY

1. Current Number of Users
2. Operational Experience
3. MTBF
4. MTTR

K. LOGISTICS

1. Retrograde Turn-around Time
2. Spares Requirements
3. Production Flexibility

APPENDIX B

A Conceptual Model to Estimate the Net Benefit (Cost) of Purchasing a Foreign Developed Defense System or Subsystem

$$\text{Benefit (Cost)} = \sum_{i=1}^{14} X_i$$

Where X_1 = Utility of additional (lost) defense capability due to early (late) availability

X_2 = Avoided (additional) U. S. development costs

X_3 = Reduced (additional) procurement costs

X_4 = Reduced (additional) logistics costs

X_5 = Inflationary savings (loss) due to early or late purchase

X_6 = Effect on other U. S. sales (off-sets)

X_7 = Impact of changes in availability

X_8 = Political benefits to appropriate alliance

X_9 = Value of gained export rights

X_{10} = Reduced R&D capability

X_{11} = Economic effect of outflow of U. S. dollars

X_{12} = Utility of increased enemy capability to counter one vice two systems

X_{13} = Data translation costs

X_{14} = Economic costs of civilian exports lost due to nonavailability of U. S. development expertise

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UNCLASSIFIED TITLE

A FRAMEWORK FOR EVALUATING CANDIDATE FOREIGN WEAPONS SYSTEMS.

ABSTRACT

(U) THE DEPARTMENT OF DEFENSE (DOD) IS UNDER INCREASING PRESSURE TO PURCHAS
BEEN DEVELOPED ABROAD. THERE ARE MANY UNIQUE ISSUES TO BE CONSIDERED BEFORE
VELOPED DEFENSE SYSTEM (SUBSYTEM). THE CONGRESS AND GAO HAVE IN THIS THESIS,
ISSUE AREAS, Y1: CHANGE IN NATO DEFENSE CAPABILITY, Y2: REAL U. S. COSTS, Y3
ICTS, IS DEVELOPED TO ASSIST DOD PERSONNEL IN CONSIDERING, FOR ACQUISITION,
AUTHOR)

INDEX TERMS ASSIGNED

ACQUISITION
DEPARTMENT OF DEFENSE
THESES
DEFENSE SYSTEMS
ECONOMICS

TERMS NOT FOUND ON NLDB

CANDIDATE FOREIGN WEAPONS SYSTEMS
NATO DEFENSE CAPABILITY
CONCEPTUAL MODEL
PURCHASE DEFENSE

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TE FOREIGN WEAPONS SYSTEMS.

D) IS UNDER INCREASING PRESSURE TO PURCHASE DEFENSE SYSTEMS AND SUBSYSTEMS WHICH HAVE
MANY UNIQUE ISSUES TO BE CONSIDERED BEFORE MAKING A DECISION TO PURCHASE A FOREIGN DE
THE CONGRESS AND GAO HAVE IN THIS THESIS, A CONCEPTUAL MODEL FOCUSING ON FOUR MAJOR
FENSE CAPABILITY, Y2: REAL U. S. COSTS, Y3: ECONOMIC EFFECTS, AND Y4: POLITICAL BENEF
ERSONNEL IN CONSIDERING, FOR ACQUISITION, FOREIGN DEVELOPED SYSTEMS AND SUBSYSTEMS. (

INDEX TERMS ASSIGNED
DEFENSE SYSTEMS
ECONOMICS

TERMS NOT FOUND ON NLDB
CONCEPTUAL MODEL FOCUSING
PURCHASE DEFENSE SYSTEMS

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