

Multinational Development of Large Aircraft

The European Experience

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for Research and Engineering



PREFACE

This report was written as part of the Multinational Weapon System Development and Production project conducted for the Office of the Under Secretary of Defense for Research and Engineering. It contributes to the growing literature on transatlantic weapon system procurement collaboration as a means of promoting NATO rationalization, standardization, and interoperability (RSI) objectives. Three European multinational large-aircraft development programs are analyzed to ascertain how much these collaborative development programs advanced NATO RSI objectives as posed in the 1970s. In the light of past intra-European experience, this report also explores the prospects and desirability of U.S. government participation in a transatlantic large-aircraft codevelopment program. It is meant to complement an overview report on European weapon systems codevelopment and other Rand studies on multinational collaboration and international technology transfer (in preparation). It should be of interest to segments of the systems acquisition community concerned with increasing NATO equipment RSI and to other government and business officials involved in transnational technology collaboration and transfer.

SUMMARY

Since the mid-1970s the United States government has advocated U.S.-European weapons procurement cooperation as a means of promoting increased NATO equipment rationalization, standardization, and interoperability (RSI). Expanded NATO equipment RSI is expected to augment military capabilities and reduce overall NATO defense costs. After consultation with its NATO allies, the U.S. government devised a three element strategy of reciprocal arms purchases, collaborative and licensed production of weapon systems, and collaborative development of similar categories of weapons ("family of weapons") to facilitate transatlantic weapons procurement cooperation.

The United States has had little experience with collaborative development, or codevelopment, although Britain, Germany, Italy, and France have codeveloped a wide variety of aircraft and other weapon systems. This report examines a small but diverse and representative group of major European large-aircraft codevelopment programs to aid in determining whether these programs achieved the benefits within Europe hoped for by U.S. advocates of transatlantic codevelopment. This report explores the European motivations and objectives for codevelopment, the effects of codevelopment on the rational management of transnational R&D funds and resources, the codevelopment program schedule, cost, and performance outcomes, and the prospects and desirability of U.S. participation in a European large-aircraft codevelopment program.

The laudable objective of rationalizing and standardizing NATO military equipment and procurement did not originate in the 1970s. Two decades earlier, NATO authorities launched a series of joint weapons procurement initiatives designed to promote these same objectives. One of the most ambitious projects arose in 1956 when NATO officials called for the collaborative development of a maritime patrol aircraft, the Breguet 1150 Atlantic. Although 14 NATO nations participated in the planning stages, only five agreed to help finance the project, and only two participants initially decided to procure the aircraft.

The varying national industrial and political concerns of the original participants doomed the Atlantic program from its inception. When France won program leadership, Britain and Canada withdrew. Subsequently these two countries, along with the United States, developed different anti-submarine warfare (ASW) patrol aircraft, which competed with the Atlantic. In addition to France, only Germany agreed to procure the aircraft, and the German decision was probably influenced by political considerations.

The Atlantic program failed in terms of both NATO equipment and procurement rationalization doctrine, and French aerospace and political policies. Partly to promote its own national objectives more effectively, France initiated a project in 1959 to codevelop the Transall C-160 medium military transport with Germany. French and German military requirements differed substantially, however. Because the project was highly political, the participating governments encouraged the formulation of joint requirements that satisfied neither military nor industrial interests, especially in Germany. Throughout its history, shifting political and

economic priorities subjected the program to a series of crises that negatively affected schedule and cost. In addition, the project suffered from a lack of centralized management. These problems contributed to serious cost overruns and schedule slippage.

France and Britain embarked on large commercial aircraft codevelopment with the Concorde in 1962 and the A-300 Airbus in 1965. As had been the case with the Atlantic and Transall programs, both of these commercial programs were also closely linked to the participants' national political and industrial objectives. The A-300 Airbus program collapsed after nearly four years of fruitless bargaining among the participants' aerospace industries, airlines, and governments (Germany had joined the project in 1966). The British formally withdrew in 1969 after which the French and Germans relaunched the effort as the A-300B Airbus program. The French and Germans reordered the program's priorities, subordinating national industrial and political objectives to commercial considerations. This resulted in a reasonably successful R&D program, although of the aircraft that eventually emerged, about 45 percent of the components plus spares are of U.S. origin.

The A-300B Airbus program is atypical of the European large-aircraft codevelopment experience. Military projects in particular have been dominated by national industrial and political priorities to such an extent that military requirements and cost and schedule objectives were seriously compromised. Examination of the Atlantic, Transall, and Airbus programs reveals that they all served the individual participant's national industrial and political objectives, often at the expense of military or commercial efficiency and the rational utilization of pooled R&D sources. Typically the problems encountered with codevelopment led to increased cost growth, schedule slippage, and performance compromises. Four general propositions emerge from this analysis:

- U.S. and European objectives for pursuing codevelopment differ fundamentally.
- Collaboration on past programs generally did not promote the rational and efficient management of national or multinational R&D resources.
- Codevelopment seems to have contributed to unsatisfactory or undesirable schedule, cost, and performance program outcomes from the U.S. perspective.
- The essential attributes of the programs that incurred the least severe schedule, cost, and performance penalties would be difficult to incorporate into a transatlantic program.

The transatlantic codevelopment of large aircraft is probably not an optimal strategy for improving NATO military capabilities and reducing NATO defense costs through increased equipment RSI.

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I. INTRODUCTION

Since 1974, and particularly since the inauguration of the Carter administration, the U.S. government has increasingly emphasized the need for military equipment rationalization, standardization, and interoperability (RSI) within the armed forces of the North Atlantic Treaty Organization (NATO). The primary goal of this policy is to augment NATO defense efficiency in the face of expanding Warsaw Pact military capabilities and growing budgetary strictures in the West. Transatlantic weapons procurement collaboration is generally perceived as the best strategy for attaining increased NATO equipment RSI. Two broad categories of benefits are expected to emerge from expanded NATO equipment RSI:¹

- Enhanced military efficiency and greater military capabilities.
- Reduced defense costs and the more efficient use of NATO R&D funds and resources through the rational division of tasks to eliminate R&D redundancies.

The first category of benefits, it is claimed, would derive from the simplification of NATO logistics management, training, and supply of ammunition, spare parts, and other stores through the deployment of standardized or interoperable equipment by the national armed forces operating under NATO auspices.² At present, for example, NATO air forces operate some 23 different nationally developed combat aircraft, most of which require different logistical support systems. Consequently, it is difficult or impossible for the various NATO air forces to coordinate logistics management and training or draw on each other's reserves of spare parts, fuel, and ammunition. Thus NATO military efficiency and military capabilities could be substantially improved, according to some authorities, through the introduction of standardized or at least interoperable equipment.

The second category of benefits would accrue primarily from the adoption of standardized rather than merely interoperable equipment. It is claimed that much if not all of the military research and development work funded in Europe is duplicated in the United States. Thus, if all NATO R&D funds and facilities are combined and all overlap eliminated, it is argued that enormous cost savings and heightened overall NATO defense industry efficiency would ensue.

The arguments for increasing NATO RSI are compelling. In view of the current concern over the widening gap between the Warsaw Pact and NATO conventional force strengths, any strategy promising to enhance NATO military capabilities and promote the more efficient and cost-effective use of NATO R&D funds and resources is bound to be attractive. The question remains, however, of how best to carry out such a strategy. The U.S. government supports transatlantic weapons procurement cooperation to promote NATO RSI. The Department of Defense has evolved a three-pronged strategy of collaboration:³

¹For more comprehensive discussions of NATO RSI, see Defense Science Board (1978); U.S. Congress (1979); Defense Science Board (1979); Comptroller General of the United States (1979).

²Standardized weapon systems are identical or nearly identical. Interoperable weapon systems may differ substantially, but they can use the same consumables, such as fuel and ammunition.

³See Meller (1979), pp. 702-703; Perry (1979), p. 49; Currie (1979), pp. 56-57; Hartley (1978), pp. 57-60; Tucker (1976).

- Reciprocal purchases of nationally developed weapon systems (the "Two-Way Street").
- Licensed production or collaborative production (coproduction) of nationally developed weapon systems.
- Collaborative international development (codevelopment) of "families" of weapons.

This report emphasizes the third element of the Department of Defense strategy. Although the U.S. government intends to pursue reciprocal sales, licensed production, and coproduction agreements with European countries, codevelopment may be the most acceptable method of transatlantic collaboration for Britain, France, and Germany. Licensed production and coproduction of U.S. designed weapon systems have become increasingly unacceptable to the European states that have substantial R&D capabilities, because these forms of collaboration limit technology transfer and do not fully exploit or benefit the R&D capabilities of all participants. In a codeveloped weapon system the entire design, research, and development process—including the cost—is shared among nations, whereas a coproduced weapon system is generally manufactured in collaboration only after one nation has independently funded and conducted the development process. Thus, given the economic, political, and military importance the three major European states attach to the maintenance of their substantial indigenous national defense industry capabilities, codevelopment may offer the most realistic prospect for transatlantic weapons procurement collaboration.⁴

The United States has engaged in licensed production arrangements with the Europeans since the 1950s and is currently involved in the coproduction of the General Dynamics F-16 fighter with Belgium, Denmark, Holland, and Norway. Yet the United States has never successfully undertaken to develop a major weapon system in collaboration with a foreign nation.⁵ Consequently, the United States possesses little firsthand knowledge of the actual process of military codevelopment. The Europeans, however, have codeveloped an impressive array of tracked military vehicles, tactical missiles, helicopters, and aircraft since the 1950s. Because of the especially costly nature of the R&D programs, European codevelopment has emphasized the high technology aerospace sector. The most extensive codevelopment programs have involved fixed wing aircraft. These include, in chronological order, the Atlantic anti-submarine patrol aircraft, the Transall military transport, the Concorde supersonic commercial transport, the Airbus wide-body commercial transport, the Jaguar attack/trainer aircraft, the Alpha Jet attack/trainer aircraft, and the Tornado multi-role combat aircraft. Thus, in contemplating transatlantic codevelopment, the United States might well profit from drawing on the rich and varied European experience.

Unfortunately, to the best of my knowledge, there are no detailed and comprehensive accounts of the European collaborative aerospace programs (with the important exceptions of the Concorde and the Tornado) in the literature. This report

⁴See Gessert (June 1979), pp. 921-930, and (July 1979), pp. 1131-1135; and Comptroller General of the United States (1979).

⁵The United States did attempt unsuccessfully to codevelop a vertical takeoff and landing (VTOL) aircraft and a main battle tank with Germany in the 1960s.

rectifies that omission with respect to the Atlantic, the Transall, and the Airbus. The rationale for the selection of these aircraft is founded on three propositions. First, no single report could reasonably be expected to cover all European collaborative programs exhaustively. Other Rand studies in progress examine the European codevelopment experience in tracked military vehicles, tactical missiles, helicopters, and small aircraft. This report and the other studies complement and support a more extensive general overview and analysis (in preparation) of the entire European codevelopment experience.

Second, although this sample of three aircraft programs is small, it is diverse. It includes both military and commercial programs exhibiting every type of organization and management structure and nearly every combination of nations observed on European codevelopment programs. In addition, it spans the entire era of European codevelopment from its inception through the 1970s. Thus, the more profound and enduring aspects of the codevelopment process may be more confidently distinguished from those associated with unique historical circumstances. The selection of this group also permits an examination of any changes in the structure and management of programs arising from the accumulation of experience. The inclusion of the Airbus allows a comparison of codeveloped commercial and military aircraft to determine if any significant differences distinguish the two types of programs.

Finally, and most important, these aircraft represent the only large aircraft designed, developed, and produced in lots of more than 20 in Europe since the late 1950s.⁶ This last point is of particular interest. Theoretically, large aircraft should be well suited for codevelopment because, although they usually entail fairly low technological risk, their size and weight make them extremely expensive to develop, produce, and procure.⁷ This observation seems to be confirmed by the actual European experience; all three of the major large-aircraft development and production programs undertaken in Europe since 1959 were collaborative. The Concorde program, one of the most ambitious European aerospace R&D efforts of the past two decades, was also collaborative. The Concorde program and other collaborative large-aircraft programs such as the Mercure have been excluded from this report except occasionally for comparison. They are generally viewed as unsuccessful programs because very small numbers of production articles were fabricated.

Through a detailed examination of the Atlantic, Transall, and Airbus codevelopment programs, this report attempts to generate responses to the following questions:

- What were the European motivations and objectives in pursuing large-aircraft codevelopment? Are these compatible with U.S. objectives for transatlantic codevelopment as posed in the 1970s?
- Have European large-aircraft codevelopment programs actually promoted the more efficient and rational management of pooled R&D resources and increased military capabilities?

⁶A large aircraft is defined here as one with an empty weight in excess of 50,000 lb and a length of more than 100 ft.

⁷Rand research in progress argues that aircraft empty weight strongly correlates to program length and is probably a proxy for complexity and thus for cost.

- How has codevelopment affected R&D program schedule, cost, and performance outcomes?
- From the viewpoint of acquisition efficiency, should the United States encourage transatlantic large-aircraft codevelopment? What barriers, if any, must be overcome to carry out such programs?

The open literature and interviews (conducted in 1978) with approximately 100 high level European defense and industry officials are the basic sources of information for this report. The statistical data on large European codeveloped aircraft programs and similar U.S. national projects, when available, are typically incomplete, usually imprecise, often not comparable, and occasionally open to varying interpretations. Nonetheless, there is sufficient evidence to determine the central motivations and objectives of the major European states in pursuing the codevelopment of large aircraft. Despite the poor quality of much of the available evidence, its sheer quantity and weight permit general observations with a reasonable degree of confidence as to their accuracy about the management of R&D resources, program outcomes, and the prospects for U.S. participation.

EUROPEAN CODEVELOPMENT AS AN ACQUISITION STRATEGY

Although the major European states have engaged in aerospace codevelopment for well over 20 years, this policy remains a controversial acquisition strategy within Europe, particularly in France but also noticeably in Britain. Before I scrutinize the large-aircraft codevelopment programs in detail, I shall review the current European debate over the efficacy of intra-European codevelopment as an acquisition strategy.

European government officials usually claim that the central economic objective of codevelopment is the reduction of national R&D costs and risks for each partner. Critics argue that this objective does not necessarily seem to lead to greatly decreased R&D redundancy or greater military and industrial efficiency. Work is distributed not to promote rationalization or efficiency but rather to maintain the widest possible range of national aerospace R&D capabilities for each participant while supporting desired levels of employment. In other words, the major European states use codevelopment as one way of avoiding national specialization and contracted national R&D capabilities in an era of increasingly restricted defense budgets. The pursuit of these objectives dictates the retention of substantial redundancies in R&D and prevents the exploitation of relative economic advantage.

In addition to sharing R&D costs and risks, codevelopment is justified in Europe as a means of extending production runs and thus lowering unit costs. Collaboration during production also theoretically promotes foreign sales by limiting competition and pooling marketing resources, contributing to a further reduction in unit costs. European advocates also assert that codevelopment contributes to program stability and technology acquisition. Finally, collaboration is often viewed in Europe as a means of combining technological resources to counter U.S. competition.

Many Europeans dispute at least some of the supposed benefits that hypothetically derive from codevelopment. The most hotly debated issue is that of cost savings. Observers agree that a codevelopment program costs more than a comparable national program. Yet, as long as a bilateral program costs less than double that of a national project, some savings will be realized. The standard empirical formulas usually advanced suggest about a 25 to 30 percent savings per partner in a bilateral codevelopment venture.

$$C_n = C_1 \sqrt{n} \text{ and } C_n = [(2n - 1)/n]C_1$$

C = Total R&D program costs
 n = Number of program participants.

However, Europeans rarely provide statistical evidence with which to verify these formulas. In addition, on more than one occasion critics have claimed that at least some aerospace codevelopment programs have cost each partner individually considerably more than a comparable national venture.⁸

Even assuming some cost savings accrue to the participants of a codevelopment program, certain European military and industrial circles remain skeptical about codevelopment because of the inefficiencies and inconveniences allegedly associated with it. Military opposition stems primarily from three perceived problems:

1. Codevelopment programs cost so much that they result in decreased unit buys and curtailment or cancellation of other, higher military priority national programs.
2. Codevelopment results in delayed deployment.
3. Codevelopment necessitates substantial requirements and specifications compromises.

In a like manner, some French, British, and German industry officials are less than entirely enthusiastic about codevelopment. According to some observers, the delays and increased costs stemming from the differences in languages, norms, work methods, laws, currencies, geographic dispersion, and so forth act as negative incentives for industry. In addition, some government and industry officials argue that codevelopment has restricted rather than expanded third country sales because codeveloped aircraft cost more and take longer to develop than nationally developed aircraft.⁹

Thus there is something less than unanimity in Europe as to the benefits of aerospace codevelopment as an acquisition strategy. However, acquisition efficiency does not seem to be the only motivating force behind European aerospace collaboration. The major European states also habitually used aerospace codevelopment to advance regional political objectives.¹⁰

⁸See, for example, Walker (1974). *Journal Official—documents administratives* (1972); and *Journal Official—documents administratives* (1973).

⁹For more extensive discussions of these problems, see House of Commons (1969); Productivity of the National Aircraft Effort, Report of a Committee appointed by the Minister of Technology, London, 1969; Mechttersheimer (1977); Walker (1974); Pinatel (1976); Tonnerre (n.d.); *Journal Official* (1973).

¹⁰The relationship between European regional political objectives and technological collaboration is discussed at length in Nau (1974) and in Williams (1973).

EUROPEAN CODEVELOPMENT AS A POLITICAL STRATEGY

The major aerospace codevelopment programs initiated by France, Britain, and Germany reflected prominent political as well as economic considerations. Beginning in the mid-1950s several political disagreements with the United States led France to press for European technology collaboration behind its leadership as a powerbase for more independent European and world policies. This strategy depended on the formation of a continental alliance, with Germany at the core (in a subordinate position), cemented through extensive military, technological, and economic collaboration. Aerospace collaboration was an especially useful instrument for pursuing these political objectives. By the late 1950s and early 1960s, Germany was rapidly becoming the most powerful industrial state in Europe. The economic and financial resources existed for reestablishing an awesome independent national armaments industry. Yet both domestic and international political constraints foreclosed this option for the German government. Widespread political, economic, and military collaboration with its still suspicious European neighbor was the only feasible means of erasing its image as a pariah nation and reestablishing more independence and influence. In addition, the German aircraft industry had all but ceased to exist between 1945 and 1955 and thus required considerable outside technical help if it was to be resurrected. For both political and technological reasons, Germany accepted aerospace collaboration as a subordinate partner with France. The most intensive period of Franco-German aerospace collaboration, from 1955 to 1964, led to the licensed production by Germany of several French aircraft and the codevelopment of the Atlantic, Transall, Hot, Milan, and Roland.¹¹

British enthusiasm for aerospace codevelopment dates from the Macmillan government's decision to seek entry into the European Economic Community (EEC) in 1961. This political decision led to the launching of the Concorde SST and Martel air-to-ground missile codevelopment programs with France, which held the key to British entry into the EEC. Although de Gaulle rejected Britain's first Common Market entry bid, Harold Wilson's Labor government tried for membership once again beginning in 1966. Somewhat earlier, the British government had appointed a select committee chaired by Lord Plowden to investigate the ailing British aircraft industry. The committee recommended collaboration with France:

The aircraft industry is one in which governments can readily promote cooperative international ventures, because they take the major share of the industry's products. At the present stage of United Kingdom foreign policy the aircraft industry has a role to play for which few other industries are so well fitted.¹²

Thus out of Wilson's foreign policy initiatives emerged the A-300 Airbus, Jaguar, AFVG, Puma, Lynx, and Gazelle programs with France.¹³

Following de Gaulle's second veto of the United Kingdom's Common Market application in 1967, Britain turned to Germany as a more useful political partner

¹¹See Willis (1968); Richardson (1966); Kohl, (1971). Hot, Milan, and Roland are tactical missiles.

¹²Report of the Committee of Inquiry into the Aircraft Industry (1965), p. 27.

¹³Wallace (1977); Camps (1964); Burt (1975); and Costello and Hughes (1976). The AFVG was a variable geometry fighter/attack aircraft that never progressed beyond the planning stage. Puma, Lynx, and Gazelle are military helicopters.

for aerospace collaboration. France, whose relations with Germany had soured somewhat in the mid-1960s, also once again courted the Federal Republic with joint aerospace proposals. Anglo-German collaboration led to the MRCA Tornado project and British entry into the Common Market. Renewed efforts at Franco-German collaboration produced less tangible political results, but the Alpha Jet bilateral development program eventually grew out of the new attempt at entente.

Nearly all major European collaborative aerospace ventures have been closely linked to specific regional political objectives. On more than one project, political objectives appear to have held the highest priority. Usually, however, the promotion of national economic objectives, primarily the maintenance of a broadly based national aerospace sector with limited national funds, has been of at least equal importance. Not surprisingly, then, the participants often appear to have failed to achieve the cost savings and benefits of economic rationalization that theoretically should have resulted from the collaborative development and production of aircraft. The goals of increasing NATO military efficiency and reducing R&D redundancies through collaboration, as advocated by the United States in the 1970s, seem to have played little or no role in shaping past European codevelopment programs.

FRANCE, BRITAIN, AND THE ORIGINS OF LARGE-AIRCRAFT CODEVELOPMENT

Robert Gessert, a rapporteur of the U.S. Defense Science Board, has observed, "France is—if not the inventor of—at least the original expeditor of a 'family of weapons' [codevelopment] concept."¹⁴ Yet Gessert also claimed that French policy was based on "France's commitment to maintaining technological-industrial capabilities to develop and produce a full spectrum of modern armaments . . . rooted in its concept of national sovereignty and autonomy within the NATO alliance."¹⁵ These two seemingly contradictory statements provide the key to understanding the European experience in the codevelopment of large aircraft. France initiated European codevelopment of major weapons in the 1950s and has played a central role in all important European aircraft codevelopment projects since, with the exception of the Panavia Tornado. France's position with respect to codeveloped large aircraft has been even more prominent. European collaborative R&D aerospace projects have thus been influenced considerably by French aerospace policy, which historically has not been directed toward the attainment of NATO rationalization and standardization goals. To the contrary, France as well as Britain collaborated to avoid European rationalization (in the sense of specialization) and to promote the maintenance and expansion of their independent national aerospace capabilities.¹⁶ These factors do much to explain the course of the large-aircraft codevelopment projects examined in detail in this report.

France began seeking financial support for weapons development from its friends and allies in the late 1950s because of procurement budget limitations

¹⁴Gessert (July 1979), p. 928.

¹⁵*Ibid.*

¹⁶For the background and content of French policy, I have relied heavily on Furniss (1964); Gilpin, (1968); Ruehl (1976); Carlier (1979); Kohl (1971); and Bellini (1974). See also Yost (1979), pp. 579-608.

arising in the burden of the Algerian war. Her goal was to develop and maintain a broad aerospace defense capability; her problem was limited procurement funds. In addition to supporting national aerospace employment and capabilities, the French also hoped that weapon procurement collaboration would advance French foreign policy objectives.

The rapid expansion of the French aircraft industry in the decade following World War II had been facilitated largely by active government support. The Fourth Republic viewed a strong and independent aircraft industry as an important element in its quest to regain its position as a great power and as the most important country in Western Europe. But beginning in 1955 the military procurement budget came under increasing strain as the Algerian war grew to serious proportions. Although total defense expenditures rose by over 5 percent annually between 1955 and 1960, R&D and procurement funds for the French aircraft industry, particularly for aircraft in the early stages of development or not suited for warfare in North Africa, dropped off precipitously. At first the Defense Ministry attempted to maintain a wide range of development projects by continuing funding of prototypes while making no commitments to quantity buying. By late 1957, however, the financial demands of the war had become so great that this policy could no longer be pursued. At that time several projects were completely halted or sharply cut back, including the Leduc 022, the Sud Super-Vautour, the Sud Trident, and the Breguet Sahara military transport. Other older projects suffered production stretchouts. The bulk of procurement funds went to military transports, ground attack fighters, helicopters, and trainers that were already in production; many aircraft and helicopters were purchased directly from the United States for immediate deployment in Algeria. By 1958, the French aircraft industry was unquestionably in the midst of a serious crisis; it desperately needed foreign sales and foreign financial support.¹⁷

Ironically, to maintain broadly based and independent aerospace capabilities France had to seek out some form of collaboration with foreign powers. The French were faced with three potential strategies for cooperation in the late 1950s: bilateral license production agreements with Germany, general weapons procurement collaboration on a NATO-wide basis, and armaments collaboration within the more limited context of the Western European Union. Politically and economically, the first option was the most attractive strategy. Such agreements would exploit the enormous aircraft market created by the 1954 NATO decision to allow Germany to rearm. In addition, such a policy would directly support French efforts to guide German rearmament and forge close links with the Federal Republic.

Germany was the natural choice for the French. France had fought desperately to avoid and prohibit German rearmament. When U.S. policy prevailed in 1954 and Germany began rearming, France immediately adapted to the inevitable by trying to control, direct, and integrate German rearmament through weapon procurement collaboration. French goals were not incompatible with Chancellor Adenauer's objectives. The German Chancellor hoped to undertake rearmament within the NATO framework in close association with the United States and France. One month after the Paris Agreements went into effect in May 1955 officially permit-

¹⁷Harlow (1967), pp. 29-30; *Aviation Week*, March 3, 1958, pp. 277-279; March 9, 1959, pp. 275-287; June 22, 1959, pp. 74-78; Carlier (1979), pp. 14, 32-34.

ting Germany to rearm, Adenauer visited France to discuss these issues. Late in that year, French officials proposed a close association of European aircraft manufacturers centered on Franco-German cooperation.¹⁸

The first French strategy proved only partly successful. French manufacturers did win two of the first four major Luftwaffe licensed production contracts. Yet the German fighter-interceptor contract, by far the largest and most important deal, went to Lockheed for the F-104 Starfighter.¹⁹ The outcome of the German fighter-interceptor competition demonstrated to the French the futility of directly competing against the U.S. aerospace industry and U.S. diplomatic power. It spurred the French to seek other ways of collaboration that might lessen or exclude the enormous influence of the United States.

The NATO apparatus, with its stress on European unity and armaments collaboration, offered the French a more formal framework within which to work. Beginning with its establishment in 1949, NATO authorities advocated rationalized defense production and weapons standardization within the Alliance. This effort aimed at rapidly building up and pooling the armaments production resources of war-ravaged Western Europe to meet the Soviet military threat more effectively.²⁰ Military aircraft in Europe had been coproduced as early as 1949 when Belgium and Holland jointly produced British aircraft and engines under license. The first cooperative aircraft procurement project initiated by NATO originated in 1953 as the Lightweight Strike Fighter program. NATO authorities drew up a general specification and conducted a design competition among the European aircraft manufacturers. The United States agreed to fund the development of national prototypes of the best designs.

Yet in 1958 when NATO officials finally selected the Italian Fiat G91 for NATO-wide adoption, all other participants in the competition except Germany refused to procure the aircraft. The French and British bitterly complained that in an effort to ameliorate the political, economic, and social situation in Italy the United States pressured NATO to reject their prototypes in favor of the G91.²¹

Although extremely disappointed with the outcome of the NATO competition, the French and British still hoped that funding for the development and production of one of their own aircraft might be secured under the auspices of another NATO collaborative project. In 1956 French authorities had suggested and NATO officials had agreed to establish a program for the collaborative development, production, and procurement of a maritime antisubmarine patrol aircraft. Having lost the NATO Lightweight Strike Fighter competition, the French and British increased pressure on NATO authorities for project leadership on this first European codevelopment venture.

Fourteen NATO nations and 22 European and Canadian companies took part in the competition. Later U.S. companies also submitted proposals. A French de-

¹⁸*Flight*, February 3, 1956, p. 145; Harlow (1967), p. 39; Furniss (1964), p. 275; Grosser (1965), pp. 83-100; Kohl (1971), pp. 54-55; Willis (1968), pp. 185-272.

¹⁹In the late 1950s German industry contracted to manufacture under license the French Nord Noratlas military transport and the Potez (Fouga) Magister jet trainer, the Italian Piaggio P.149, and the F-104.

²⁰See James (1967), p. 1; NATO Information Service (1962), p. 107; Beer (1969), p. 131; Calmann (1967), p. 2; Vandevanter (1964), pp. 14-16.

²¹See *Interavia*, September 1957, p. 803; NATO Information Service (1962), pp. 112, 114; Beer (1969), pp. 139-140.

sign, the Breguet 1150, won the competition in October 1958. There are indications that this was partly a political decision to placate the French because of the rejection of the French Mirage fighter by the Luftwaffe and the impending public announcement of the choice of the F-104 Starfighter for the German interceptor of the 1960s. As a consequence of this choice, the British withdrew entirely from the program.

In the French view (and the British), NATO collaboration usually implied adopting American aircraft. Yet the French and British would participate in collaborative ventures only if their own national designs were adopted and they managed the program. With the Atlantic program, the one NATO program administered by the French, most NATO countries refused to procure the aircraft. In addition, the French felt that when they collaborated within the NATO framework the predominant position of the United States within the Alliance rendered it difficult for them to pursue independent political objectives through the programs.

Fear and suspicion that the United States would dominate NATO collaborative programs led the French to seek aerospace cooperation within the more limited context of the Western European Union (WEU), of which the United States was not a member. As a forum for armaments collaboration in the late 1950s, the WEU presented several advantages from the French perspective over collaboration under NATO auspices. It provided a framework in which France could collaborate with Germany and Italy, with less U.S. and British interference. In such a context France could more effectively assert its priorities and interests in armaments collaboration with the two other continental powers. In the long run France hoped that such collaboration would contribute to the formation of a continental bloc to counter the influence of the Washington-London "axis."²² Although the formation of the WEU was seen at the time of the decision to allow Germany to rearm as a facesaving gesture to France, it actually provided a potentially useful framework for French collaboration with and control over German rearmament and the foundation for a continental counterweight to the United Kingdom and United States.²³

The WEU charter called for weapon procurement collaboration among its members. As early as January 1957, France and Germany established a joint "military committee" to explore the possibilities for the codevelopment and coproduction of aircraft, missiles, and tanks. As originally conceived, France would supply most of the technical expertise, and Germany would carry much of the financial burden. The two countries soon founded a joint experimental rocket test center at St. Louis in Alsace, and agreed to codevelop a tank. Italy was kept informed of these actions; later in the year the German and French defense ministers agreed in principle to codevelop a military transport aircraft with Italian participation.²⁴

France's unhappy experience with NATO competitions and her foreign policy goal of forming a Franco-German bloc led her to intensify her collaborative efforts with Germany under the auspices of the WEU. While the NATO partners squabbled over who was going to finance the Atlantic, France and Germany went ahead

²²Furniss (1960), pp. 273-275.

²³NATO Information Service (1962), pp. 28-29; Hanreider (1967), pp. 49-52, 65, 83; Beer (1969), p. 80; Furniss (1960), pp. 270-273.

²⁴Furniss (1960), p. 173; *Flight International*, April 25, 1968, p. 214; *New York Times*, July 18, 1957, p. 3.

to develop a new military transport (Transall C-160) bilaterally outside the context of NATO.

The Atlantic and Transall programs satisfied fundamental French and German needs. Collaboration allowed the French to launch two major aircraft programs that may have been financially impossible on a national level, thus helping to maintain French national aerospace capabilities and employment levels. French foreign policy goals benefited by virtue of French participation in the creation of a continental bloc in Europe. The programs contributed to a joint European aerospace capability able to compete with American industry. The two projects helped revive and expand Germany's aerospace industry quickly and in a politically acceptable framework. In addition, they contributed to Adenauer's foreign policy of reconciliation and collaboration with France. In the late 1950s and early 1960s, these goals were far more important than NATO's rationalization and standardization efforts or the objective of procuring the highest performing aircraft, for the cheapest price, in the least amount of time.

The Anglo-German-French A-300 Airbus program demonstrates that even with a commercial program, national industrial and regional political considerations remained ascendant on European large aircraft programs throughout the decade of the 1960s. From 1965 through 1969 the participating governments negotiated a long series of industrial tradeoffs without ever permitting the program actually to get under way. The most serious mistake committed during these negotiations was the French concession, made against their better judgment, permitting the Airbus to be equipped with a Rolls Royce engine, which the British had insisted on for domestic industrial reasons. Major political difficulties, the persistent refusal of most airlines to order the proposed aircraft, and eventual British withdrawal led to the collapse of the program.

In 1969, France and Germany revamped the program management structure, the program R&D philosophy, and the proposed aircraft's specifications. The R&D program for the new Airbus, rechristened the A-300B, progressed smoothly. After the French and Germans had agreed to supplant technological nationalism with commercial realism, the Airbus became first a reality and second a probable success. Market factors had induced the two partners to compromise their "all European" philosophy: 45 percent of the value of the aircraft plus spares was of U.S. origin.²⁵

Unfortunately the A-300B Airbus program probably does not represent a fundamental change in the European approach to collaborative development. The unique commercial priorities imposed on it certainly were not in evidence on the Atlantic, Transall, or Concorde programs before it, nor are they particularly prominent on the MRCA Tornado and Alpha Jet programs that followed it.

The A-300B thus far has been unique in the history of large European aircraft codevelopment programs. In all other cases, particularly when there was an assured market with the participants' military forces, cost-effectiveness considerations and military requirements deferred to national industrial and diplomatic objectives. In addition, the French have traditionally been more successful in securing their own objectives than the other European participants in these programs.

²⁵No European engine was available, and the only candidate was deferred by the British decision to support the Lockheed L-1011 program rather than the less promising Airbus.

The 1978-79 restarts of the Atlantic and Transall production programs and the accompanying French negotiations with former partners clearly suggested that French policy with respect to large codeveloped military aircraft had not changed.²⁶

Multinational collaborative development of large aircraft helped France in its quest for aerospace independence and leadership in Western Europe, advanced British national technological and diplomatic objectives, and contributed to the development of German national aerospace capabilities. The price paid often was substantial project schedule slippage, cost growth, and probable aircraft performance shortfalls compared with similar U.S. aircraft. This is hardly surprising, given that the primary goals of these projects, with the possible exception of the A-300B, did not extend to promoting the rational and cost-effective pooling of the participants' R&D and industrial resources. The participants routinely compromised military and commercial requirements on grounds of national economic interest or foreign policy considerations. There is in this experience little to encourage the United States to participate in the transatlantic codevelopment of large military aircraft. Nonetheless, some of the programs or aspects of programs examined in this report clearly were more successful than the others in terms of cost, schedule, and performance outcomes. Those projects starting with similar national requirements, delegating most program authority to the industrial level, managed primarily by a single partner (usually France), and stressing cost-effectiveness considerations over political and industrial objectives seem to have resulted in the most favorable outcomes from the American perspective. If the transatlantic codevelopment of large military aircraft is deemed desirable and possible, the United States would be well advised to participate in programs having these attributes.

²⁶See *Aviation Week and Space Technology*, November 1977, p. 41; *Air International*, August 1978; *International Defense Review*, January 1979, pp. 115-117; *NATO's Fifteen Nations*, January 1979.

II. THE BREGUET 1150 ATLANTIC ASW PATROL AIRCRAFT

In the 1950s and early 1960s NATO authorities strongly favored procurement standardization and rationalization goals strikingly similar to those advocated in the 1970s. The Atlantic codevelopment venture emerged in the late 1950s as part of an extensive NATO effort to institutionalize collaborative weapons procurement within the Alliance. Despite the success of the R&D program, it did not lead to widespread adoption of the aircraft by NATO members. Nor did it successfully establish a precedent for future aircraft codevelopment projects. The Atlantic R&D program succeeded only because of a fortuitous and brief concurrence of French national industrial objectives and NATO RSI policies. French, British, and U.S. aerospace nationalism doomed this codevelopment program from the beginning as an attempt at increasing Alliance RSI and assured that no followup projects in the early 1960s would survive beyond the planning stage. These early NATO RSI efforts failed because France, Britain, and apparently even some elements in the United States viewed collaborative ventures as just another means, along with direct sales and licensed production agreements, of aiding their national aerospace industries.

ORIGINS

The NATO-wide need for a Lockheed Neptune anti-submarine warfare (ASW) patrol aircraft replacement was first recognized during the 1956 Annual Review of the Alliance's overall military posture. In March 1957, a French representative suggested, and the NATO Defense Production Committee agreed, to establish a "Group of Experts" to examine the possibilities for collaborative development of a Neptune successor.¹

In two respects the development of a new generation ASW aircraft seemed to be an ideal and unique opportunity for NATO collaboration. First, at least seven NATO countries had the same replacement schedule for their aging Neptunes. Second, the NATO military representatives of these countries all generally agreed on the nature of the threat and the broad requirements the new aircraft must meet. The key problem with the Neptune was its small size; the vast array of new ASW electronic gear developed primarily by the United States and the increased number of crew members necessary required a significantly larger aircraft. Most NATO military authorities also agreed that a Neptune replacement must have a longer range, higher speed, pressurized fuselage, and decreased internal noise levels.²

The NATO Group of Experts, designated A/C 126, first met on April 16, 1957. The group included about 30 operational and technical experts representing 14 nations. Acting on instructions from the Defense Production Committee, the group

¹James (1967), p. 11; Vandevanter (1964), pp. 17-18; Beer (1969), p. 132.

²*Flying Review International*, June 1965, p. 29.

asked the Standing Group of the NATO Military Committee in Washington, D.C. to define the operational requirements for the aircraft, which they did in September. Little disagreement had been expressed over requirements; the Standing Group represented only France, the United Kingdom, and the United States, and their assessments of the threat and the means to counter it in this instance generally were in agreement. By mid October, A/C 126 had reconvened to develop detailed specifications and equipment needs.³

NATO elevated the status of the program in December by designating weapons collaboration as a central goal of the Alliance. At the NATO meeting of heads of government in Paris, the United States heavily promoted the "family of weapons" concept, laying the groundwork for the Hawk, Sidewinder, and Luftwaffe fighter-interceptor licensed production efforts. But France and the United Kingdom began to view this American drive for increased Alliance standardization and pooling of resources with considerable skepticism. Britain, still smarting from the recent German rejection of their Saunders-Roe 177 as the Luftwaffe fighter interceptor, and the French, angered over the NATO selection of the Italian G91, accused the United States of seeking standardization through the Alliance-wide adoption of U.S. backed, designed, or manufactured equipment. The Europeans supported these accusations with the rumors that the United States was pressuring Germany to choose an American fighter-interceptor to produce under license. France and the United Kingdom also noted that while paying lip service to the NATO ASW patrol aircraft project, the U.S. Navy had independently issued its own specification for a Neptune replacement.⁴

Royal Air Force and Canadian actions further dampened the initial high hopes for extensive adoption of the NATO maritime patrol aircraft within the Alliance. Canada had already issued a separate specification; during 1957 the Canadian government decided to modify the Britannia commercial transport to fulfill its ASW needs. The RAF Coastal Command also announced that it hoped to continue using the aging Hawker-Siddeley Shackleton into the late 1960s. Thus, even before the project had commenced, three of the potentially largest users had apparently decided not to purchase the NATO aircraft. Abruptly the projected market seemed to fall from over 300 aircraft to around 100.⁵

Interest in the project remained high, particularly among the French and British. The French were especially determined to win the design competition. They were the first to promote a collaborative solution for the development of a Neptune successor. Their government could not afford independently to develop and produce an entirely new ASW aircraft. As with the NATO Lightweight Strike Fighter competition, France hoped to aid its aircraft industry by winning design and project leadership of this new collaborative program.⁶

The French government supported Breguet in the NATO competition. The company had broad experience with multi-engined transports, including the 763

³*Aviation Week and Space Technology*, June 10, 1963, pp. 76-77; *Royal Air Force Flying Review*, May 1963, p. 27.

⁴*Flying Review International*, June 1965, p. 29; *New York Times*, January 3, 1959, p. 6; Beer (1969), p. 172.

⁵*Flying Review International*, June 1965, p. 29; Gunston (1977), pp. 136, 139; *Roundel*, May 1958, pp. 2-4.

⁶*Journal of the Royal Aeronautical Society*, March 1963, p. 154; *American Aviation*, April 23, 1956, p. 121.

Provence and the 940 STOL transport. The company also designed and produced the BR. 1050 Alizé, France's only postwar national ASW patrol aircraft. But late in 1957, the shortage of funds due to the demands of the Algerian War forced the French army to cancel its order for a military transport version of the Provence, and the only thing preventing a cancellation of the 940 project was a large injection of U.S. funds. Additionally, Breguet's Taon 1001 had just lost the NATO Lightweight Fighter competition and the French government couldn't support the 1100 version designed to French air force specifications. Thus Breguet had the necessary design and manufacturing capabilities and needed to win the NATO competition to ensure their full employment.⁷

A/C 126 spent the closing months of 1957 and the early months of 1958 developing detailed specifications in response to the operational requirements formulated by the Standing Group in Washington. On March 21, 1958, A/C 126 submitted the joint specifications to 22 aircraft firms in six European nations and Canada. NATO authorities requested that industry draw up international agreements for production sharing. June 21 was designated as the closing date for the submission of design studies.⁸

With the background of growing tensions over the German fighter-interceptor affair, France and the United Kingdom were determined to prevent the participation of U.S. industry in the airframe design competition.⁹ Yielding to French and British pressure, A/C 126 decided to exclude U.S. firms from the aircraft design study competition. The program rapidly became a two-way contest between the French and British for project leadership. Despite the large number of European firms involved in the design competition, in reality only a very small number of French and British firms held any realistic prospect of being chosen as the pilot firm. Few of the contenders had the production capability or any design experience in long-range multi-engine large aircraft. The firms expressing high interest in the project, possessing the necessary capabilities to lead it, and supported by their governments included only Breguet and Sud in France and Avro in the United Kingdom. Because of the ambivalent stance of the RAF and the enthusiasm of the French, France's firms seemed to have the best prospect of winning. Breguet took the lead in organizing an international consortium even before the June 21 deadline for design submissions. On June 6, Breguet signed a cooperative agreement with Sud, Avro, Dornier, and Fokker. All the companies pledged to cooperate on production if A/C 126 chose any one of the design proposals of the five firms.¹⁰

The whole equation altered in early June when the United States demanded inclusion in the design competition. The worsening American balance of payments situation and pressure from U.S. aircraft manufacturers encouraged a fundamental turnabout in government policy. The United States increasingly began to shift from promoting European aerospace independence to aggressively selling its own

⁷Gunston (1977), p. 134; *American Aviation*, April 23, 1956; p. 120; *Aviation Age*, June 1957, p. 26; *Aviation Week*, March 3, 1958, p. 277.

⁸*Royal Air Force Flying Review*, May 1960, p. 19; *Journal of the Royal Aeronautical Society*, March 1963, p. 154.

⁹*Aviation Week*, July 28, 1958, p. 18; June 10, 1963, p. 77.

¹⁰*Royal Air Force Flying Review*, May 1960, p. 20; *Flight International*, November 15, 1962, p. 770; Vandevanter (1964), p. 28.

products in direct competition with the European firms. A sudden demand that American firms be included in the design competition and that the June 21 deadline be extended 30 days clearly reflects this reversal. A/C 126 refused to extend the deadline but did forward the specifications to several U.S. firms. With only about three weeks left, the American companies did not have time to formulate serious design studies, and the French and British successfully neutralized the last minute American threat.¹¹

By June 21 the Group of Experts had received 21 design proposals. Exactly four months later, after several meetings, A/C 126 chose the Breguet 1150 as the winner. Some observers found this decision surprising in view of Avro's experience in the field.¹² French officials insisted the decision was made purely on technical merit. Others implied that political considerations were at least as important in this NATO decision as in the choice of the Lightweight Strike Fighter.¹³ Indeed, it is likely that two outside factors in addition to the technical merits of the Breguet design, the German rejection of the French Mirage III in favor of the F-104 Starfighter for licensed production and the general political situation in France, may have influenced the decision of A/C 126.

By the end of 1957, many observers believed Germany had already decided on the Lockheed F-104 Starfighter as its fighter-interceptor. Throughout early 1958, it was commonly believed that the Germans delayed making their choice public and continued to examine the Mirage III merely to placate the French until some sort of compensation could be offered France to soften the blow. In May, however, Charles de Gaulle took over the government of France in the midst of the country's worst political crisis since the war. De Gaulle's views on a militarily strong France conducting an independent foreign policy founded on Franco-German collaboration are well known. De Gaulle almost immediately increased pressure on the Federal Republic to adopt the Mirage III. After a highly successful meeting between de Gaulle and Adenauer in September, French officials became increasingly confident that the Mirage would be chosen. Yet U.S. pressure seems to have undermined de Gaulle's efforts. By early October, Germany again announced a delay in the final decision and agreed to send another study mission to the United States to examine American aircraft and production techniques.¹⁴

French officials were extremely irritated with this turn of events. Some reportedly raised the stakes by designating purchase of the Mirage as the test case for Franco-German cooperation, something desired as much by Adenauer as by de Gaulle. In mid-October a storm of protest broke out in France when German newspapers reported that the Starfighter had definitely been chosen. The French expressed much bitterness against Germany and the United States. According to one French official, "It is becoming increasingly clear to us that American companies regard NATO equipment programs as their exclusive prerogative. We can't accept this and don't intend to."¹⁵

¹¹Vandevanter (1964), pp. 62-63; *Aviation Week*, July 28, 1958, p. 18.

¹²*Flying Review International*, June 1965, p. 29.

¹³*Aviation Week*, July 29, 1958, p. 18; *Journal of the Royal Aeronautical Society*, March 1963, p. 155.

¹⁴*New York Times*, July 10, 1958, p. 6; *Aviation Week*, January 6, 1958, p. 34; February 3, 1958, p. 34; March 31, 1958, p. 25; August 4, 1958, p. 32.

¹⁵*Aviation Week*, November 3, 1958, p. 2; also *Aviation Week*, October 13, 1958, p. 34; November 3, 1958, pp. 26-27.

By October 1958, French dissatisfaction with NATO weapons collaboration programs had dramatically escalated. The Taon had not been chosen as the Light-weight Strike Fighter. During the year, it became obvious that it also would not be chosen for a second generation fighter as NATO authorities had originally intimated. The German interceptor competition outcome, the emerging Sidewinder and Hawk programs, and the U.S. reversal of policy during the ASW patrol aircraft competition demonstrated to the French that the Americans intended to dominate collaborative NATO armaments programs. In addition, the French political scene was functioning in a climate of crisis as the new government faced a general election and a referendum on the new constitution. No one knew if France would regain political stability or what the new government's attitude would be toward the Alliance. These circumstances probably influenced the decision for the NATO ASW patrol aircraft. Significantly, the Germans waited for three days *after* the selection of the Breguet 1150 to announce the official rejection of the Mirage III. In these circumstances, Germany, and perhaps the United States, pressed for a decision in favor of a French rather than British design.¹⁶

NATO HESITATION, FRENCH DETERMINATION

A/C 126 had completed its mission on October 21, 1958, by recommending the adoption of the Breguet 1150 as the NATO ASW patrol aircraft. All the organizational arrangements remained, however, including financing, work sharing, schedule, and management structure. But for the moment there seemed no major obstacle in the way of full-scale development of Breguet's design: a twin Rolls-Royce Tyne turboprop conventional midwing aircraft with a pressurized upper deck "double bubble" fuselage, designed to carry a crew of 12 up to 370 mph on patrols of 12 to 18 hours.¹⁷

It wasn't until January 30, 1959, however, after Germany had officially announced the adoption of the Lockheed F-104, that the NATO Armaments Committee (formerly the Defense Production Committee) approved the recommendations of A/C 126. Representatives of the participating governments then sat down to negotiate the details of program implementation.

The allocation of financial responsibility immediately emerged as a far more difficult task than expected. At first observers believed this problem would be resolved by January 1959; in reality it took an additional ten months. Most of the participants rapidly lost interest in the project once the subject of financing was raised. Back in March 1958, when A/C 126 approved the final specifications, the number of active participants had already fallen from 14 to 9 (United States, United Kingdom, France, Belgium, Canada, Germany, Italy, Holland, and Norway). When A/C 126 chose the Breguet 1150 over the British proposal, the United Kingdom withdrew from the project, and Avro dropped out of the consortium formed by Breguet. Canada, Norway, Italy, and Belgium declined to participate in joint financing. Negotiators brought Belgium back into the discussion, however, by offering Avro's position in the Breguet consortium to a group of Belgian firms called

¹⁶For background, see Willis (1968), pp. 276-277, 279-280.

¹⁷*Jane's All the World's Aircraft* (1960), p. 12.

Association Belge pour l'Avion Patrouilleur (ABAP) made up of Sabca, Fairey, and Fabrique Nationale. (Siebel also joined Dornier later to form an association called Seeflug.) The United States offered to pay a fixed percentage of development costs; France, Germany, Belgium, and Holland argued over who would pay what percentage of the rest. Basing financial contribution on a nation's projected buy seemed appropriate, but none of the participants were willing to commit themselves irrevocably to purchasing a specific number of aircraft. Thus, the negotiations were long and arduous.¹⁸

The French government did not wait for its NATO partners to approve funding and apportion financial responsibility. This was a project needed by the French navy and the French aircraft industry. The French government unilaterally launched the R&D program on February 11, only 12 days after final approval by the NATO Armaments Committee. Over the next ten months the French government and Breguet conducted the project as if it was a national venture with foreign subcontractors. The French government provided all funds. Breguet directed the technical aspects, subcontracting work to the designated foreign companies. In early December the NATO participants finally settled on joint financing arrangements and structures for governmental oversight and industrial management. By this time, however, the French had been running the program for some time; they accepted the new arrangements but did not actually give up much of their authority.¹⁹

Original NATO Funding Arrangements

Finally, in December 1959, the participants settled on a formula for sharing expenses on an austere RDT&E program that included two flying prototypes. The total funds allocated and the precise division of funding responsibility are not available in the literature. Apparently, the United States agreed to fund about one-third of the total cost of research and development through the Mutual Weapons Development Program. A condition was imposed requiring the Europeans to purchase U.S. components through the U.S. Navy equal in value to the contribution made by America to R&D.²⁰ The other participants decided to split the remaining development costs according to initially projected buys stated at the beginning of the program. The negotiators also agreed to allocate work to the participating firms according to financial contribution. The first provisional orders for the aircraft were as shown in Table 1.²¹

France probably also initially agreed to pay about one-third of the R&D program costs, with most of the final third split between Holland and Germany. These estimates have been extrapolated from less than precise information and therefore are little more than educated guesses. Nonetheless, France and the United States were undoubtedly the major contributors to the project, although Germany prob-

¹⁸*Aviation Week*, December 15, 1958, p. 35; June 10, 1963, p. 77; *Journal of the Royal Aeronautical Society*, March 1963, p. 155.

¹⁹*Aviation Week*, June 10, 1963, p. 77; *Journal of the Royal Aeronautical Society*, March 1963, pp. 155-156, 160.

²⁰*Aviation Week and Space Technology*, June 14, 1965, p. 244.

²¹James (1967), p. 12.

Table 1

PROVISIONAL ORDERS FOR THE ATLANTIC

France	70	Portugal	12-14
Holland	20	Norway	6
Germany	18	Belgium	0-6

ably significantly increased its percentage contribution during the development and tooling phase as the likelihood of Dutch and Belgian orders decreased.²²

The French strategy had prevailed. By independently funding the project for ten months, the French Defense Ministry and Breguet had strengthened their position with respect to the NATO negotiations. Now the other participants agreed to make substantial financial contributions to the research and development of a French designed aircraft, and agreed to procure it. France, of course, had to accept a joint management structure for the program. But all the evidence suggests that the French, represented primarily by René Bloch of the Defense Ministry and Henri Ziegler of Breguet, continued to dominate the venture.

Government Oversight

On December 4, 1959, the participants established the project Steering Committee (see Fig. 1). The Steering Committee was composed of one government representative from each of the five countries financing the program plus a NATO observer and secretary. Chairmanship of the Committee rotated among the five national representatives on a six-month basis. All decisions had to be unanimous. Yet the Steering Committee met only once a month. Day-to-day governmental control of the program was vested in the Technical Subcommittee and the Administrative Subcommittee, the former of which was by far the most important. For the most part the Steering Committee approved the decisions of the Subcommittee; national representatives rarely resorted to their veto power.²³

The Steering Committee decided not to establish a new and independent executive agency to carry out its decisions, let and supervise industrial contracts, and arrange for testing and acceptance of equipment. Instead the Committee invested this authority in the *Direction Technique et Industrielle de l'Aéronautique* (DTIA), the French equivalent of the British Ministry of Aviation. This government agency, of course, had been performing these duties on the project all along.²⁴

Observers have often remarked that despite the veto authority possessed by all five national representatives, the project progressed as if it were under the authority of one man. This is partly because of the commanding position of French Navy Captain René Bloch on the Steering Committee. Bloch served as Chief Engineer for French Naval Aviation and Assistant Director of Aeronautics for International Affairs, French Defense Ministry. In addition, he exercised extensive authority on

²²*Flying Review International*, June 1965, p. 33.

²³*Journal of the Royal Aeronautical Society*, March 1963, p. 158; *Aviation Week*, June 10, 1963, p. 73; *Flight International*, November 9, 1961, p. 724.

²⁴*Journal of the Royal Aeronautical Society*, March 1963, p. 158.

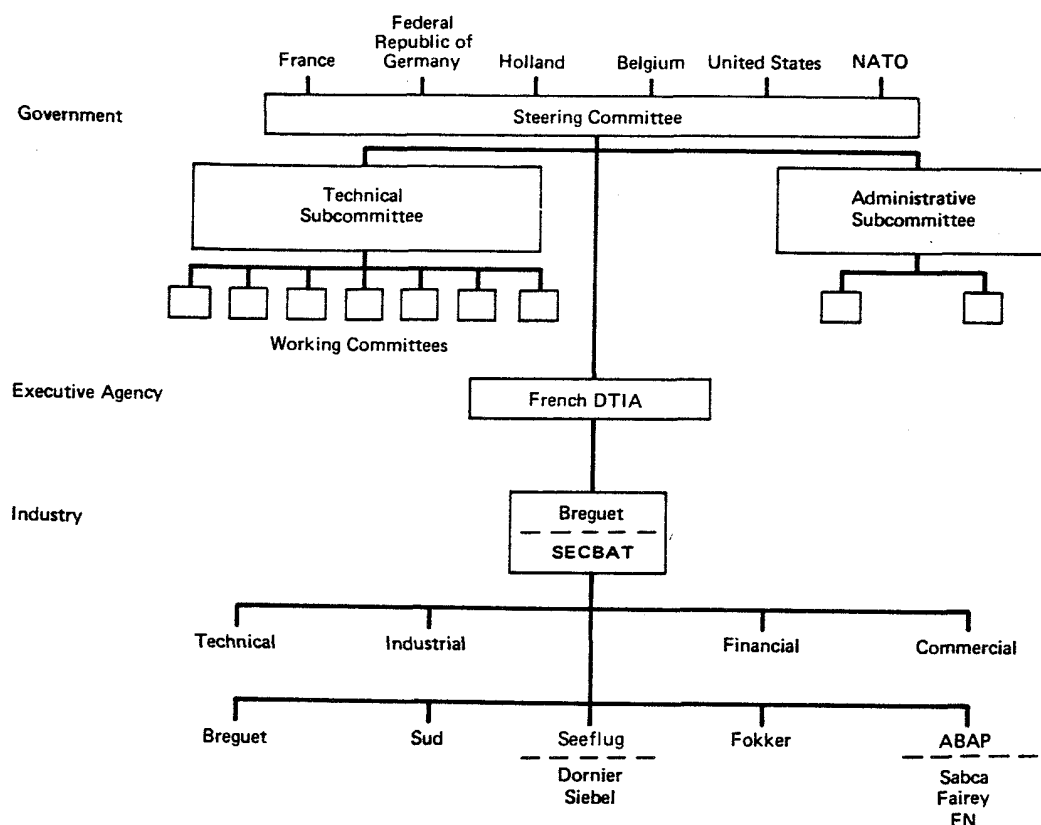


Fig. 1—Atlantic organization: Pilot firm

the NATO ASW patrol aircraft project. First, he was the French representative on the Steering Committee, serving as chairman in 1961. He alone possessed overall executive coordinating authority for the project within the DTIA. Finally, and most important, he acted as Permanent Chairman of the Technical Subcommittee, thus directly overseeing all the most important day-to-day development decisions. Observers implicitly recognized Bloch as the spokesman and coordinator of government oversight for the project.²⁵

Industrial Organization

Three days after the establishment of the Steering Committee, the participating firms formed a joint company called Société Européenne pour la Construction du Breguet Atlantic or SECBAT. As in the case of government oversight, the French managed to retain a position of preponderance in this new joint industrial management organization. For the first ten months, the DTIA had let contracts to Breguet, which, as the prime contractor, subcontracted to the other participating firms. Then all the firms involved organized into a legal association managed by

²⁵Ibid.; *Flight International*, November 15, 1962, p. 770.

SECBAT in which they all held a share. Breguet, however, was granted overall management authority over SECBAT. Parallel to the structure of the Steering Committee, an administrative committee with a rotating chair and representatives from all the participating firms headed SECBAT. Yet while retaining legal authority, the administrative committee delegated all final authority to a permanent and nonrotating Managing Director, who appointed technical, industrial, financial, and commercial directors. As Managing Director of Breguet, Henri Ziegler also became managing director of SECBAT. Henri Ziegler's role on the industrial side was even more influential than Bloch's on the governmental side. In addition, Ziegler represented SECBAT in all its dealings with the DTIA. Not surprisingly, Ziegler appointed Frenchmen to the other key posts in SECBAT, Technical Director and Production Director.²⁶

Breguet's central position as prime contractor and design leader remained unchallenged after the formation of SECBAT. Why then was the new joint company founded? In short, Ziegler, the real spirit behind SECBAT, promoted its formation to lessen Breguet's financial liability, especially later during the production stage. SECBAT was a means of spreading legal financial responsibility and risk among all the industrial participants in the program. In other respects, however, Breguet continued unilaterally in its original capacity as prime contractor. It produced the manuals on common methods, standards, specifications, and tolerances for the other firms. It also conducted the negotiations with Rolls-Royce over the licensed production of the Tyne turboprops, with Bloch also playing a central role in the discussions. Even after five NATO countries agreed to jointly fund the program, the French position remained ascendant.²⁷

Work Sharing

Early in the project officials had agreed that prototype and production work would be allocated according to initially projected buys and financial contribution. Much of the steering committee's efforts were directed toward balancing work allocation with financial contribution. Negotiators fairly rapidly hammered out a satisfactory formula. French firms received the bulk of the airframe work. The negotiators divided up detail design work, prototype construction, and series production as shown in Table 2.²⁸

Ensuring a share on component work contracted outside the associated countries (presumably excluding the United States) emerged as one of the most difficult tasks. Prototype contracts to outside firms stipulated that they must license or subcontract to firms in the participating countries during the production phase. Breguet arranged to borrow and purchase the Tyne turboprops from Rolls-Royce for the first two prototypes. A license agreement was negotiated for the production phase, however, with the French again receiving the largest share of the work.²⁹ Hispano-Suiza coordinated the engine program and carried out final assembly

²⁶Ziegler (1973), p. 32; *Journal of the Royal Aeronautical Society*, March 1963, pp. 159, 162-163.

²⁷*Flight*, November 9, 1961, p. 724; *Journal of the Royal Aeronautical Society*, March 1963, pp. 162-163; Ziegler (1973).

²⁸*Journal of the Royal Aeronautical Society*, March 1963, p. 159; *Flight*, November 9, 1961, p. 724.

²⁹*Flying Review International*, February 1965, p. 16.

during the production phase. (See Table 3.) This firm also manufactured the landing gear, but subcontracted work to ABAP. The French firm Ratier arranged for the licensed production of the propellers in cooperation with De Havilland. With this sort of complicated subcontracting and licensing agreement the negotiators came very close to dividing up the work according to the initially agreed shares.³⁰

Table 2

INDUSTRIAL WORK SHARING ON THE ATLANTIC

Breguet:	Main fuselage, final assembly, flight testing.
Sud:	Outer wings from engine nacelles out.
Dornier:	Fuselage tailcone and horizontal stabilizer.
Siebel:	Vertical stabilizer.
Fokker:	Wing center sections and engine nacelles.
ABAP:	Airframe components.

Table 3

INDUSTRIAL WORK SHARING ON THE TYNE TURBOPROP

Company	Percent (by value)
Hispano-Suiza (France)	44
Maschinenfabrik Augsburg-Nurnberg (Germany)	28
Fabrique Nationale (Belgium)	8
Rolls-Royce (U.K.)	20

THE RESEARCH AND DEVELOPMENT PROGRAM

By January 1960, joint financing, government oversight, industrial management, and work sharing had been arranged under NATO auspices. By this time, the R&D program had already been underway for over ten months as a French project. French practices, the shortage of French funds, and the difficulties encountered in arranging for joint governmental financing had all determined the nature of the R&D program: extreme austerity. Because of budgetary restrictions, it was divided into at least two distinct but overlapping phases. Phase I, inaugurated by the French government on February 11, 1959, called for the design, construction, flight testing, and development of two prototypes. By mid-1960, French authorities began urging the expansion of the scope of the initial R&D program to include more prototypes, ground test airframes, and initial production tooling preparations. France's partners, however, showed even less enthusiasm for financing this second

³⁰*Flight*, November 9, 1961, p. 724; *Journal of the Royal Aeronautical Society*, March 9, 1963, p. 159; *Flying Review International*, June 1965, p. 29. A substantial number of the avionic components were purchased in the United States, although Compagnie Générale de Télégraphie sans Fil built the main search radar unit. See *Aviation Week and Space Technology*, June 10, 1963, p. 72.

phase of the R&D program than they had for the first. In exasperation, the French government once again proceeded unilaterally and launched Phase II in January 1961. Funding for this phase covered the construction of a third prototype and one preproduction aircraft, full-scale static and fatigue test airframes, and initial production tooling. For over one and a half years the French government financed Phase II on its own.³¹

The unwillingness of the other participants to fund Phase II stemmed from resentment over French domination of the project and increasing skepticism about the likelihood of widespread NATO adoption of the French aircraft. In the first place, the United States continued to push forward on its own ASW patrol aircraft program.³² Second, the United Kingdom still refused to commit itself to the Atlantic. The French had long hoped that the United Kingdom and even Canada might eventually rejoin. But the United Kingdom still made no decision, and the Canadians continued on with their Argus program.³³ Even more disheartening, the Dutch and Belgians also refused to place firm orders for the Atlantic. Thus, by the end of 1961, only the French government had made a firm order for the purchase of 20 aircraft, although Germany had reportedly placed an order for an undisclosed number.³⁴

Despite these problems, the French continued with Phase II using their own funds. Up through the flight testing of the second prototype, the project progressed ahead of schedule and with remarkably few problems. On October 23, 1961, prototype 01 took off on its maiden flight from Breguet's Toulouse-Blagnac field a week ahead of schedule. Four months later prototype 02 successfully made its first flight, also a week earlier than planned. Less than two months later, however, on April 19, 1962, 02 exploded in midair. The ensuing crash totally destroyed the aircraft and killed all three crewmen. The cause of the accident was never officially revealed, but it delayed flight testing. Atlantic 03 did not fly until ten months after the crash.³⁵ Atlantic 04, the first built to production standards, first flew on September 10, 1964, three or four months behind schedule. The first operational delivery to the French navy took place at the end of 1965, over one year later than originally planned.³⁶

Despite the crash of prototype 02, Atlantic project spokesmen have always claimed that no major technical difficulties delayed the R&D program. It seems likely that the extreme austerity of the program and the difficulties in arranging international financing left the project with little maneuvering room once 02 crashed. Funds were so short at the beginning of the program that Breguet arranged to borrow the first three Tyne turboprops from Rolls-Royce for the first prototype. The unwillingness of the associated countries to share costs of more than

³¹*Aviation Week and Space Technology*, June 10, 1963, p. 77; *Journal of the Royal Aeronautical Society*, March 1963, p. 157; *Flying Review International*, June 1965, p. 33.

³²Gunston (1977), p. 145.

³³*Royal Air Force Flying Review*, February 1963, pp. 29, 49; *Aviation Week and Space Technology*, November 27, 1961, p. 52.

³⁴James (1967), p. 30; *Air Pictorial*, January 1962, p. 22; *Armed Forces Management*, December 1961, p. 35.

³⁵The third prototype had been lengthened by the insertion of a 3.28 ft section behind the cockpit. Also an electronic countermeasures (ECM) radome had been added to the vertical stabilizer and magnetic anomaly detector (MAD) boom installed in the tail. These changes were unrelated to the crash of prototype 02.

³⁶*Flying Review International*, June 1965, pp. 34-35; *Aviation Week and Space Technology*, June 10, 1963, p. 77; November 27, 1961, p. 52; August 10, 1970, p. 51; *Royal Air Force Flying Review*, February 1963, pp. 28-29.

two prototypes coupled with French budgetary restrictions meant that Phase II, which France had supported unilaterally for 18 months, would be unusually austere and stretched out. When 02 crashed, the DTIA Phase II contract with Breguet did not call for the completion of another prototype for nearly a year. The flight test program had to continue during that period with only one aircraft rather than two.

The associated powers did belatedly come to France's aid, but partly for political considerations. Throughout 1962, Franco-German collaboration intensified with the continuing progress of the Transall project and the establishment of a joint test center at Istres. De Gaulle's scheduled tour of Germany in September, which led to the signing of the Franco-German friendship treaty of January 1963, reinforced fears that a Franco-German bloc was coalescing. By this time the Atlantic project was beginning to be perceived as primarily a Franco-German bilateral affair closely linked to de Gaulle's objective of loosening Germany's ties with Washington. In addition, disillusionment with NATO collaboration was spreading as the NATO basic military requirement (NBMR) 3 and 4 aircraft competitions degenerated into promotional contests for national projects. The United States and other NATO allies may have wanted to see the Atlantic program kept alive as the only on-going example of NATO aircraft codevelopment. On June 29, 1962, the United States, Belgium, Holland, and Germany finally agreed to help finance Phase II. It seems likely, however, that Germany's share of the financing increased at this time.³⁷

SCHEDULE, COST, PERFORMANCE

Most published accounts claim the Atlantic development program was highly successful, especially in terms of schedule. Contemporary observers often pointed to it as the prime example of how to conduct international collaboration.³⁸ The development program experienced only about a 17 percent schedule slippage. All the slippage occurred after the first flight of the third prototype and seems to be related to the loss of prototype 02 and the lack of a sufficient prototype batch, as already discussed. Factors other than the friction of collaboration, such as budgetary restrictions, also affected the development program schedule. And with a schedule slippage of only 17 percent, the Atlantic ranks among the more successful postwar aircraft development projects anywhere in terms of this criterion. There is little reliable published information on total program development costs. Bloch and Ziegler have always maintained that the project, using fixed price contracts, never experienced cost overruns.³⁹ However, French budgetary data show a 64.65 percent increase in anticipated program authorizations dedicated to the Atlantic program during R&D.⁴⁰ This increase was substantially larger than that required by all other French tactical aircraft during

³⁷*Aviation Week and Space Technology*, June 10, 1963, p. 77; *Journal of the Royal Aeronautical Society*, March 1963, p. 160; Beer (1969), p. 141.

³⁸Ziegler (1973), p. 32.

³⁹*Aviation Week and Space Technology*, June 10, 1963, p. 77; *Journal of the Royal Aeronautical Society*, March 1963, p. 160; Beer (1969), p. 141; Ziegler (1973), p. 32.

⁴⁰The increase in authorizations may have included funding to procure production articles.

the same *programme loi* with the exception of the Transall.⁴¹ Even with this substantial increase in authorizations, program cost growth forced the French government to decrease its projected initial buy from 27 to 20 Atlantics, a 25 percent reduction.⁴²

Nearly all contemporary accounts stress that the Atlantic met or exceeded all performance expectations, although the aircraft's honeycomb sandwich skin caused serious corrosion problems once the aircraft were deployed. The French and Germans soon discovered defects in the bonded seals that allowed salt water to penetrate and corrode the aluminum honeycomb. The resulting decrease in fatigue lifetime required a major overhaul and retrofit program that included improved anti-corrosion seals and fittings. By early 1970, only 20 percent of Germany's Atlantics were flying, in part because of this problem.⁴³

NATO'S FIRSTBORN GROWS UP AN ORPHAN

As the first large-scale attempt to promote RSI goals through the widespread NATO adoption of a collaboratively designed and developed European aircraft, the Atlantic program proved to be unsuccessful. Originally, officials had expected sales of up to 300 Atlantics as the NATO powers replaced their Neptunes. In the end, four NATO countries eventually procured a total of 87 aircraft; of these, nearly one-half were purchased by the French government. During the first four years of series production, total sales outside of France amounted to 20 aircraft to Germany. The decision of the United States, Britain, and Canada not to procure the Atlantic but rather develop competitive aircraft undoubtedly contributed to this failure.

Breguet had signed an agreement with Grumman for the licensed production of the Atlantic late in 1961. But within six months, the U.S. Navy began taking delivery of the Lockheed P-3A Orion. Instead of procuring the Atlantic, the United States eventually sold Orions to Norway, Holland, Canada, and Spain, in addition to Australia, Iran, and New Zealand. Europeans complained that the United States was promoting the Orion to the Europeans while blocking sales of the Atlantic to South Africa. Thus, especially to the French, NATO RSI continued to mean the purchasing of U.S. equipment, as it had on the F-104, Hawk, and Sidewinder projects.⁴⁴

Britain's final decision not to procure the Atlantic also exasperated the French. After the United Kingdom withdrawal from the project in 1958, the French had maintained close contacts with British officials on the Steering Committee, Technical Subcommittee, and through Breguet and Avro. In 1965, however, Britain authorized its own national project to develop the Hawker-Siddeley HS.801 Nimrod based on the Comet jet airliner. By this time, it was clear that in addition to Norway and the United Kingdom, Belgium, Holland, and Portugal would not be ordering the Atlantic, at least in the immediate future. French and German officials viewed

⁴¹Carlier (1979), p. 72.

⁴²Ibid., p. 71.

⁴³*Aviation Week and Space Technology*, March 2, 1970, p. 20, and August 10, 1970, pp. 51-52.

⁴⁴Beer (1969), pp. 139, 144-147; *Flight*, November 9, 1961, p. 723; *Aviation Week and Space Technology*, June 10, 1963, p. 72; June 14, p. 243; Vandevanter (1964), pp. 62-63.

these developments with growing bitterness. As one remarked, "Without an export market today, it is almost pointless to build a modern sophisticated aircraft."⁴⁵

Because of budgetary restrictions and higher than expected unit costs, the French themselves failed to place an order equal to their originally stated requirement for 70 aircraft. Early in 1963, the French and German governments signed a production contract for 20 aircraft each. As other orders failed to materialize, the French government began to press Germany to join it on a joint followup order of the same size, but political, economic, and budgetary considerations prevented the Germans from going beyond their originally stated buy. After Britain gave the go-ahead to the Nimrod program in February 1965, France went ahead on its own and contracted for a second batch of 20 Atlantics.⁴⁶ Yet by mid-1968, with no more sales forthcoming the last Atlantics were nearing completion and a major Breguet facility faced a shutdown.

Desperately trying to win new orders, Breguet proposed a wide number of variants, including a civil version of the Atlantic, but to no avail. Shutdown of the production line was averted at the last moment when a sudden, urgent Dutch need for ASW aircraft unexpectedly arose.⁴⁷ SECBAT won a Dutch order for nine Atlantics partly by promising quick delivery through the diversion of four aircraft originally intended for the French. Ongoing negotiations with the Dutch government and Fokker-VFW over participation in the Airbus project possibly also could have played a role in the Atlantic order.

Production was further extended when the Italian government placed an order for 18 Atlantics on October 25, 1968. SECBAT agreed to offset the buy with Italian industrial and governmental participation in the program. SECBAT redivided the production work with Breguet emerging as the major loser. Raising the total order book to 87, the new Italian buy allowed production to continue well into 1974.⁴⁸

CONCLUSIONS

In retrospect the Atlantic program might be characterized as both the greatest achievement and the most disturbing failure of NATO's early efforts to promote Alliance equipment standardization and procurement rationalization through codevelopment. Despite the success of the collaborative R&D program, it never served as a usable model for future European programs. In 1959 the initial optimism over the Atlantic program led NATO authorities to establish formal RSI procedures based on the joint determination of future NBMRs (NATO Basic Military Requirements). Between 1959 and the end of 1966 NATO authorities developed and promulgated no less than 49 NBMRs, several of which pertained to major aircraft collaborative procurement opportunities. Yet not one of these 49 NATO

⁴⁵*Aviation Week and Space Technology*, June 14, 1965, p. 243; see also *Flying Review International*, January 1964; August 1965; p. 23; *Aeronautics*, June 1960, p. 62; *Royal Air Force Flying Review*, February 1963, pp. 29, 45; James (1967), pp. 12-13.

⁴⁶*Flying Review International*, January 1964, p. 65, November 1964, p. 4, April 1965, p. 5; *Air Pictorial*, January 1964, p. 22.

⁴⁷Early in 1968 the Dutch ASW aircraft carrier *Karel Doorman* burned and the Dutch government decided not to repair it and return it to service.

⁴⁸*Interavia*, January 1969, pp. 64, 66-67; *Jane's All the World's Aircraft* (1971-72), pp. 48-49; *DMS Market Intelligence Reports*, "Breguet 1150 Atlantic," September 1973, pp. 1-2.

basic military requirements led directly to a collaborative development or procurement program. According to one authority commenting on this period, "Probably no part of the military side of NATO has been so divisive as the constant wear-and-tear of failures to produce standardized equipment for forces supposed to be prepared for a common emergency."⁴⁹ Thus, instead of representing the pioneering venture of a long series of NATO codevelopment programs, the Atlantic remains the sole example of an aircraft codevelopment program initiated and brought to fruition by NATO authorities.⁵⁰

Given this perspective, the Atlantic program might be viewed as a most extraordinary achievement indeed. The most remarkable aspect of NATO's early RSI efforts is not that the NBMR system failed but that the Atlantic program succeeded as well as it did. Clearly this program was exceptional. Its success was due in large measure to a unique set of circumstances, never repeated:

1. With nearly all the major NATO navies dependent at least in part on the P-2V Neptune for airborne ASW tasks, replacement schedules for the aircraft generally coincided.
2. Because participants perceived the threat (mainly missile-equipped, long-range, high speed Soviet submarines) and the combat environment in the same way, they readily agreed on similar requirements for the aircraft to meet the threat.
3. The requirements of endurance, range, and size, coupled with the capabilities of the European aviation industry at that time, meant the aircraft would be of conventional design. These factors facilitated agreement on specifications.
4. No major technological advance was sought or attempted. The Atlantic airframe and engines are conventional. Even the controversial honeycomb sandwich skin had been developed earlier by Breguet on the Taon and by Sud and Fokker. The engines for the prototypes were procured off the shelf from Rolls-Royce.
5. Only a few firms had adequate capabilities to do the work. Breguet and Avro were probably the only realistic possibilities as project leaders. By default, most of the electronic equipment had to be procured from the United States.
6. The project enjoyed a single chain of command. Even after the establishment of SECBAT, Breguet, through Henri Ziegler, managed the industrial level. French influence also predominated on the government level in the Steering Committee. Both sides worked through the French DTIA. For two periods totaling well over two years, the French government funded phases of the R&D program on its own. To a large extent the venture resembled a French national project with foreign risk-sharing subcontractors.
7. The United States eventually paid for a large share, probably one-third of R&D costs.

⁴⁹From François Duchène, *Beyond Alliance*, quoted in James (1967), p. 14.

⁵⁰James (1967), pp. 9-11.

8. Austerity and incrementalism characterized the R&D program. The participants originally authorized only two prototypes, one of which flew with borrowed engines. Final production tooling and series production were not begun until most of the R&D program was complete. The program included no duplication of component manufacture. With the exception of the A-300B Airbus, it was the only European codevelopment venture with only one final assembly line.

This exceptional combination of advantageous circumstances never again existed on any NATO or intra-European military aircraft codevelopment program. All subsequent NATO attempts at codevelopment floundered on disputes over requirements, specifications, replacement schedules, and most of all, program leadership. This last element emerged as the most crucial and intractable issue. British and French enthusiasm for NATO aircraft codevelopment waxed and waned according to the benefits specific programs were perceived to bestow on their own national aerospace industries.

Indeed, aerospace nationalism also wrecked the Atlantic program as a NATO RSI exercise. The French participated only because their design had been chosen and they managed the program. Once the French had garnered program leadership, the British withdrew. Following the preferences of their own national military establishments and aerospace industries, the British, Canadians, and Americans independently developed their own national ASW aircraft. The initial flush of enthusiasm for NATO procurement collaboration was rapidly dissipated by such actions as the Norwegian cancellation of its provisional order for Atlantics after the United States agreed to satisfy Norwegian requirements with U.S. aircraft.⁵¹

The progressive dropping away of participants discouraged and infuriated the advocates of NATO RSI. Fourteen NATO nations had successfully written a joint requirement and initial specifications, six nations had provisionally agreed to procure the aircraft, five had participated in the funding and management of R&D, yet only two nations were willing to buy the finished product. When the first production Atlantic was formally rolled out, not one NATO official was in attendance. By this time, most observers recognized the program for what it had become: a bilateral Franco-German venture almost entirely dominated by the French. Norway, Holland, Spain, Canada, and the United States opted for the P-3 Orion.⁵² The Royal Air Force acquired the Nimrod. NATO RSI objectives had been overridden by the exigencies of technological and industrial nationalism. Despite the most favorable circumstances with respect to requirements, specifications, replacement schedules, and industrial capabilities, this collaborative program did not lead to extensive NATO adoption of the aircraft.

The efficient management of combined R&D resources does not appear to have been a key program priority. Industrial nationalism played a much more prominent role. Participation in the program for both Britain and France depended on the selection of one of their own national designs and designation of one of their own national firms to lead the project. It is likely that political as well as purely technical reasons dictated the final NATO selection of the Breguet 1150 design. Despite the large number of European firms included in the design competition, the

⁵¹James (1967), p. 12.

⁵²Italy and also Holland procured some Atlantics.

choice was really between nations rather than firms. Both Britain and France designated preferred pilot firms chosen for domestic industrial reasons. No competition existed in the selection of associate contractors. Industry representatives negotiated the makeup of the international consortium before NATO authorities chose the winning design and pilot firm. The same designated consortium designed, developed, and manufactured the aircraft. Authorities allocated R&D and production work according to projected unit buy and financial contribution, not according to concepts of relative economic advantage or cost effectiveness.⁵³

The friction of the collaborative process may have adversely affected program outcomes. The Atlantic program appears to have suffered a 17 percent schedule slip and a cost overrun of as much as 65 percent. Despite the unprecedented degree of agreement over requirements and specifications, continual disputes arose that may have resulted in cost penalties and, particularly in the early phases of the program, probably contributed to an extended schedule. Negotiators often disagreed over equipment selections. For example, lengthy debates occurred over matters as trivial as whether the altimeter should be calibrated in meters or feet with the zero at the bottom or the top.⁵⁴ Much difficulty was encountered in arranging and allocating joint funding responsibilities and on establishing the parameters and magnitude of the R&D program. These disputes would have caused considerably more schedule slippage had not the French proceeded with the program unilaterally.

Finally, industrial nationalism not only obstructed NATO-wide participation, but it precluded genuine equality of representation and was clearly directed against the U.S. aerospace industry. France dominated the program. In 1977 the French government authorized the restart of Atlantic production on a purely national basis after failing to interest the former SECBAT partners in further collaboration. Both the original and second generation Atlantic "ANG" were promoted in direct and intense competition with the U.S. P-3 Orion. During the original NATO design competition, the Europeans had demanded the exclusion of U.S. industry. All participants welcomed U.S. government financial support, but both France and Britain were suspicious of U.S. intentions, particularly after the belated American attempt to include U.S. firms in the design competition.

In short, the Atlantic program was a disappointment for NATO RSI advocates in the early 1960s. It proved to be an equally unhappy experience for the French. Despite the substantial foreign aid received for the development of what amounted to a French aircraft, extensive NATO-wide sales failed to materialize. The French had been forced to negotiate with up to 13 other nations during the early stages of the program, and share program management with four other nations, yet in return they initially received orders from only one foreign participant. As a means of supporting the French aerospace industry, the NATO apparatus was clearly shown to be only slightly more effective than direct competition with the United States for German license production contracts such as the Luftwaffe fighter-interceptor. In a classic understatement, the French Defense Minister announced in 1965 that the Atlantic program had "not fulfilled all our hopes."⁵⁵ Because of their

⁵³With the possible exception of avionics.

⁵⁴*Journal of the Royal Aeronautical Society*, March 1963, p. 158.

⁵⁵Beer (1969), p. 159.

disappointment and frustration, the French had already decided much earlier to explore other mechanisms for aerospace collaboration outside the context of NATO. Once an effective alternative framework was found, the French and other participants could drop the pretense of adhering to NATO RSI objectives and concentrate on the more serious business of assisting their national aerospace industries and countering U.S. aerospace competition.

III. THE TRANSALL C-160 MILITARY TRANSPORT

Long before the French Defense Minister's 1965 expression of disillusionment with the Atlantic NATO program, France had increasingly resorted to bilateral arrangements outside the NATO framework for aerospace collaboration. In order to more effectively advance its own political and industrial objectives with less U.S. and British "interference," France by the late 1950s had already turned to the Western European Union (WEU) as a forum for armaments collaboration. On January 21, 1958, France, Germany, and Italy signed a formal agreement under the auspices of the WEU. The defense ministers of the three nations announced that their governments would "carry out jointly, according to NATO principles, developments and productions in the weapons fields."¹ By February a joint military committee set up five subcommittees of experts including one on aircraft and one on missiles and communications gear. France would be the leader on aerospace projects, Germany on tanks, and Italy on joint naval programs.² Observers immediately speculated that the continental powers were forming a bloc to counter the "Anglo-Saxon condominium in NATO."³

THE EMERGENCE OF THE TRANSALL PROGRAM

For the first six months of its existence, the WEU armaments collaboration pool accomplished very little. During this period the French government became paralyzed as the Fourth Republic collapsed. In addition, Britain and the United States launched an aggressive campaign to widen the pool to all the members of the WEU and coordinate it with NATO collaboration policies. This strategy succeeded in neutralizing French designs until de Gaulle returned to power in May and resurrected the original tripartite agreement with its anti-United States and anti-United Kingdom overtones. In June, authorities established a Franco-German-Italian committee to determine joint requirements for a new transport to replace the Nord Noratlas 2501.⁴

As early as August 1954, the French generated requirements for a Noratlas replacement. As the Algerian situation worsened, the need for a long-range heavy military transport grew. In 1957, budgetary problems forced the government to cancel its orders for the four-engine Breguet Sahara transport, a modified commercial Provence. The French then began lobbying for the codevelopment of a Noratlas replacement within the context of the French-German-Italian arms production pool.⁵

The French could have easily arranged a purchase or licensed production

¹*New York Times*, January 22, 1958, p. 14.

²*New York Times*, February 22, 1958, p. 4.

³*New York Times*, February 10, 1958, p. 22.

⁴*New York Times*, March 6, 1958, p. 5; March 7, 1958, p. 5; March 26, 1958, p. 12; Beer (1969), p. 153.

⁵Abafourd (1963).

agreement with Lockheed for the C-130A Hercules in order to meet their needs. Lockheed indeed made a generous offer in 1959. However, the French policy of promoting extensive design capabilities and maintaining employment in the aerospace industry rendered such an option unacceptable. With the Noratlas production run rapidly nearing completion, Nord had no prospects for new aircraft design and production orders. The French government's inability to fund the development of a new national transport or either of Nord's fighter prototypes meant the company's three major aircraft assembly plants faced the prospect of a shutdown by 1961.⁶

In certain respects the situation in German industry paralleled that in the French. By the late 1950s Noratlas licensed production occupied nearly the entire capacities of the German northern industrial group, composed of Weser Flugzeugbau, Hamburger, and Siebelwerke-ATG. The northern industrial group also desired to expand its transport design capabilities and maintain employment and production after the completion of the Noratlas program. Weser and Hamburger were particularly interested in expanding their transport design and production capabilities. Thus, sometime in 1957 these two firms began examining possible design concepts for a Noratlas replacement.⁷

The Italians had less military and industrial need to develop a new transport than the French and Germans. Although interested in transport development, Fiat was fully occupied with the G91 program. In addition, the Italian government had already funded the development of a small, medium-range military transport. The Italian Air Force chose to order this aircraft before the June meeting of the trilateral arms pool aviation subcommittee. Nonetheless, the Italians kept their options open by participating in all the early joint transport development discussions.⁸

Between June and December 1958, the representatives struggled to work out the joint requirements for the transport. Here the situation contrasted dramatically with that of the NATO ASW patrol aircraft. In the latter venture, despite the large number of participants, all were in basic agreement over requirements. In the transport project, however, French and German requirements were in many respects diametrically opposed. On the whole, Italian requirements coincided with those of Germany.

The French desired to develop an aircraft similar in many respects to the C-130A. They wanted a long-range, large capacity transport designed for maximum performance in a desert environment to support their military commitments in northern Africa. The Germans argued for a short to medium range, medium capacity transport with extreme STOL⁹ capability and designed to operate best in the climatic conditions of Central Europe (see Table 4). The Italians also presented requirements for a medium range STOL transport. Very little has been revealed in the literature on how the participants reached a compromise starting from such radically divergent positions. What seems clear from the joint requirements arrived at is that neither side's requirements were entirely satisfied; however, it appears that the Germans did most of the compromising.¹⁰

⁶*Interavia*, May 1957, pp. 401-402; *Aviation Week*, June 15, 1959, pp. 56-59.

⁷*Aviation Age*, June 1957, p. 42; *Aviation Week*, March 3, 1958, p. 597; *Interavia*, April 1960, pp. 475-476, 480; *Der Flieger*, July 1962, p. 254.

⁸*Interavia*, May 1957, p. 425; June 1958, p. 615; *Flight*, January 25, 1957, p. 111-114.

⁹Short takeoff and landing.

¹⁰*Interavia*, September 1960, p. 1156; December 1963, p. 1908.

Table 4

ORIGINAL FRENCH AND GERMAN REQUIREMENTS VS JOINT TRANSALL
REQUIREMENTS IN 1960

German Requirements	French Requirements	Joint Requirements
Tactical transport	Long-range transport	Tactical long-range transport
450 mi radius with 8 ton payload	740-2800 mi range with up to 16 ton payload	2800 mi range; 8 ton payload 1370 mi range; 16 ton payload
Maximum STOL capability (Takeoff run 900 ft)		Moderate STOL capability (1970 ft to clear 32.8 ft barrier)
Unpressurized cabin	Pressurized cabin	Pressurized cabin
Cargo compartment dimensions based on international rail dimensions		Complied with international rail dimensions
Four engines	Two Tyne turboprops	Two Tyne turboprops
Components optimized for Central European climatic conditions	Components optimized for North African environment	Optimized for North Africa

The choice of the engines illustrates how the French successfully promoted the interests of their own aerospace industry through collaboration. Most of the designs submitted during the NATO ASW patrol aircraft competition, including the Breguet 1150, had specified the use of the Rolls-Royce Tyne R. Ty. 20 turboprop. Breguet chose this engine for technical reasons but also because the French anticipated that Hispano-Suiza, with its long history of licensed production of Rolls-Royce engines, would arrange for a substantial share of the coproduction of the engine in France. The French therefore urged the Germans to accept the Tyne as the engine for the collaborative transport. The high power rating of this engine meant that only a two-engine design was practical. Consequently, all French transport design proposals designated two engines. German design proposals, based on Luftwaffe preferences, specified four less powerful engines. The French position prevailed.¹¹

The same holds true for the load and range requirements and for the choice of other components. The joint requirement for a 2800 mile range with an eight ton load and a maximum capacity of 16 tons for a range of 1370 miles greatly exceeded the original German requirement for a simple tactical transport with a 450 mile operating radius with an eight ton payload. In opposition to the German requirement, the French also succeeded in specifying a pressurized fuselage for high altitude long-range flights. Reportedly, the air conditioning system and other components were optimized for desert conditions instead of the central European theater as the Germans wanted. Finally, with respect to STOL capability, the two

¹¹Airevue, December 1962, p. 516; *Flying Review International*, May 1966, p. 535; *Interavia*, May 1957, p. 408.

partners initially agreed to develop two separate versions. The basic aircraft would possess only moderate STOL capabilities. But a German version would mount auxiliary jets under its wings to reduce takeoff distance by 50 percent. The French agreed to provide for the attachment of these engines in the design, although the Luftwaffe, because of mounting costs, never took advantage of this minor concession.¹²

Germany agreed to collaborate on the development and production of an aircraft whose performance parameters substantially exceeded or differed from the original requirements determined by the Luftwaffe, Defense Ministry, and German industry. After initially rejecting the C-130A as too large for their needs, the Germans agreed to codevelop an aircraft that was in the same class. Once it became clear that the joint requirements would reflect French preferences, the Italians felt no need to sacrifice their own requirements and remain in the program. In 1959, they withdrew from the venture; later they developed the G222, a smaller transport that more closely met their original requirements.¹³ The German capitulation over joint requirements took place within the same intensely political and competitive industrial context as the selection of the Breguet 1150 and the Lockheed Starfighter. From beginning to end the Franco-German transport project was extensively influenced by political, diplomatic, and industrial considerations. As Hochmuth noted, "In 1958 both German industry and the German government were still bending over backwards to be conciliatory as they regained their influence."¹⁴ Having only just begun the reconstruction of its aircraft industry after 1955, Germany needed extensive foreign technical aid to build up its capabilities. The French, unlike the Americans, offered the Germans a major role in the actual development rather than just the licensed production of a transport aircraft. Germany traded off military requirements in return for technology acquisition. Politically, Adenauer had formed a strong bond of friendship with de Gaulle at their September and November 1959 meetings. At these meetings the German Chancellor had tacitly agreed to support the General's independent policies based on a Franco-German bloc in return for de Gaulle's support over the Berlin crisis. But Adenauer was also committed to close links with the United States. After the rejection of the Mirage III in favor of the F-104, the Transall remained the only tangible symbol of active Franco-German bilateral weapons collaboration. The Germans seem to have felt compelled by political necessity to bow to the most important French demands on the joint transport project after the bad feelings engendered by the G91 and Starfighter deals.¹⁵

European and Alliance politics played an important if not decisive role in the formative stages of both the Atlantic and Transall projects. Once the two programs had been launched, any similarities between the two rapidly faded. In some respects, the NATO ASW patrol aircraft venture proved highly successful, in large part because it was conducted in a manner not strikingly different from a French national project. The joint transport program, however, remained embroiled in the volatile politics from which it originally emerged.

¹²*Flying Review International*, May 1966, p. 535; *Airevue*, December 1962, p. 516; *Interavia*, September 1960, p. 1156; *Der Flieger*, July 1962, p. 254.

¹³*Flight International*, April 25, 1968, p. 614.

¹⁴Hochmuth (1974).

¹⁵See Grosser (1974), pp. 480-481; Willis (1968), pp. 274-281.

THE PROBLEM OF PROJECT LEADERSHIP

Observers close to the Transall program have often commented that it suffered from the lack of centralized, unified governmental and industrial management. In this respect the Transall program differed from the Atlantic program. The unwieldy management mechanism probably emerged out of a unique set of political and economic circumstances in 1959.

By January 1959 the French and Germans had agreed on joint requirements. Defense Ministry officials selected Nord, Weser, and Hamburger, the firms collaborating on Noratlas licensed production, to design and develop the transport jointly. Blume Leichtbau, a design office closely associated with Focke-Wulf, also was designated to take part in the design work.¹⁶ Negotiators directed the firms to base the final joint design on proposals submitted earlier by Nord, Breguet, Weser, and Hamburger.¹⁷

Representatives of the designated firms met in Bonn in late January 1959 and signed an agreement to design and develop the transport. No "shadow company" or other formal unified management structure was established; rather, the firms established the loosely structured Transall (Transport Allianz) Working Group.¹⁸

By July, Weser had been designated project leader. The reasons behind this choice remain unclear. The history of European aircraft codevelopment demonstrates that the French are loath to relinquish design or project leadership on programs in which they participate. And in this situation, Nord definitely possessed greater expertise and capabilities than Weser and probably produced the original design. The usual explanation found in published sources is that Germany intended to procure more of the aircraft. There is some truth in this. Contemporary observers spoke vaguely of an initial production run of about 200 aircraft followed by a second batch of the same size, both split evenly between the French and the Germans. It was fairly clear, however, that the French probably could not afford a buy of that magnitude because of budgetary limitations. The Algerian War, de Gaulle's new austerity measures, and his emphasis on nuclear weapons development had dried up the sources of money for new aircraft development and procurement. Having compromised extensively on joint requirements, and being in a much stronger budgetary position, Germany demanded its fair share of control over the Transall venture.¹⁹

Yet the choice of Weser was also linked to continuing discussions between German industrialists and Lockheed over the licensed production of the C-130 Hercules. Early in 1959 the U.S. firm launched a major sales drive in Europe as a followup to its Starfighter sale. Very much aware of the Transall project, Lockheed offered the French, Germans, Italians, and other European nations a proposal for the licensed production of the C-130A that, they claimed, would save \$100 million and five years of development time compared with cost and schedule of a European developed transport. France expressed no interest in the offer. Italy, already disen-

¹⁶At the end of 1963 Focke-Wulf would merge with Weser to form Vereinigte Flugtechnische Werke (VFW). Heinkel would join them the next year.

¹⁷*New York Times*, January 29, 1959, p. 8; *Aeronautics*, June 1957, p. 71; *Interavia*, December 1963, p. 1908; September 1960, p. 1156; *Flight International*, April 25, 1968, p. 614; *Aviation Week*, January 26, 1959, p. 29.

¹⁸*New York Times*, January 29, 1959, p. 8; *Interavia*, December 1963, p. 1908.

¹⁹*Aviation Week*, January 22, 1959, p. 74; *Flight International*, April 25, 1968, p. 614.

gaging from the Transall program, responded that the C-130A was too large for its needs. The German northern group, however, found the offer attractive because they feared a production gap between the Noratlas and Transall programs. The German industrialists recommended to the Federal Armaments Technology and Procurement Agency that licensed production of the C-130A be undertaken.²⁰

Understandably the French were displeased with this development. As a further irritant, the French had also become involved in an increasingly bitter competition with the Germans over reequipping the Belgian and Dutch air forces. Eventually Holland and Belgium decided to procure the F-104 in conjunction with Germany, once again jeopardizing the Mirage III program. In response, the French pressured the German government to oppose the C-130A deal. The evidence suggests that project leadership for Weser was in part a French concession to induce the German government to block the C-130A deal and remain in the Transall program.²¹ The French strategem worked; the German government rejected the licensed production agreement negotiated with Lockheed.

PROJECT ORGANIZATION

By winning project leadership, the Germans had guaranteed nothing more than equality with the French. A completely equal bilateral management structure emerged (see Fig. 2). The result was a total lack of central authority on every level, which often produced stalemates whenever the partners disagreed. Industry officials established two separate design teams, one representing the three German firms and the other representing Nord. A joint coordination team was also organized at Bremen (Weser). The participating companies formed a bilateral technical directorate with eight members (two from each company) that met once a month. A bilateral management committee of four industrial representatives met twice weekly at Lemwerder. In addition, technical working committees were created for each major subassembly. This proliferation of bilateral committees seriously complicated program coordination.²²

The four firms rapidly completed the final joint design proposal. In July 1959 Working Group officials submitted the proposal to the Franco-German-Italian armaments pool air subcommittee. The joint design called for a high-wing, turboprop, long-range heavy military transport, christened the Transall C-160, similar in appearance and dimensions to the Lockheed C-130A. There are indications that the basic design and layout originated with Nord. Indeed, Nord alone displayed the first model of the Transall at its pavilion at the 1959 Paris Air Show. In addition, both the Nord 262, developed from the Max Holste Super Broussard, and the Breguet 941 incorporated many design features also seen on the Transall.²³

²⁰*New York Times*, February 22, 1959, p. 3; March 1, 1959, p. 35; *Aviation Week*, June 9, 1958, p. 23; January 26, 1959, p. 29; February 16, 1959, p. 33; March 9, 1959, pp. 295-299; June 15, 1959, pp. 56-59; *Interavia*, December 1963, p. 1909.

²¹*Aviation Week*, June 20, 1960, pp. 167-168; *New York Times*, December 9, 1959, p. 8; *Interavia*, June 1963, p. 282; December 1973, p. 1909.

²²*Aviation Week and Space Technology*, June 2, 1969, p. 114; June 10, 1963, p. 83; *Interavia*, September 1960, p. 1157.

²³*Aviation Week*, July 13, 1959, p. 61; *Interavia*, December 1963, p. 1908; *Jane's All the World's Aircraft* (1960-61), pp. 135-136; 1961-62, p. 56.

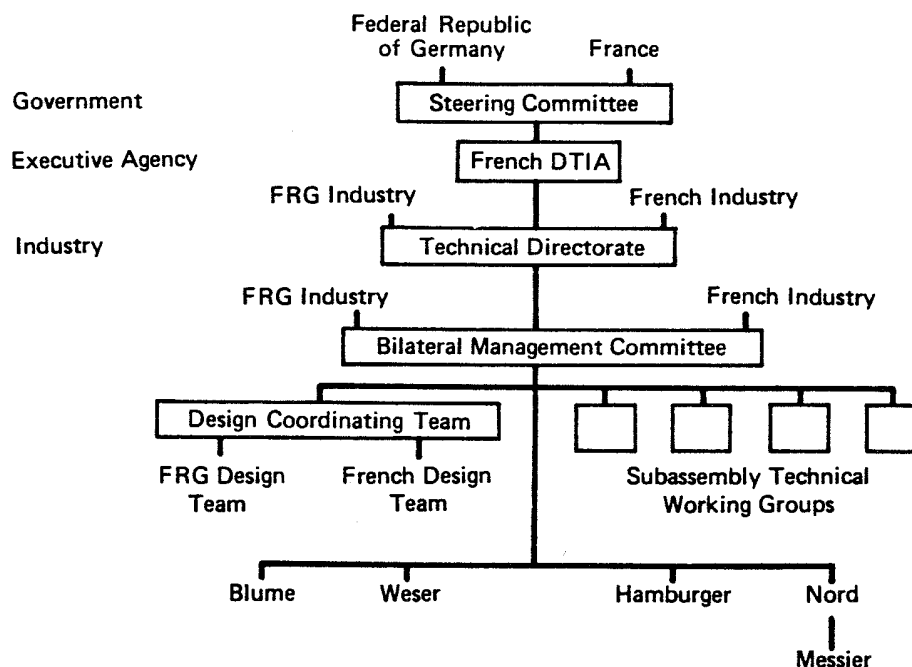


Fig. 2—Transall Organization: Bilateral

The German and French authorities accepted the basic design proposal but recommended minor modifications. In November the two Defense Ministries officially approved the final design proposal. The next month government officials signed the necessary initial agreements so that work could begin in January 1960.²⁴

The two governments divided all development costs and work on a 50:50 basis. Initially the prototype work was allocated as shown in Table 5.²⁵ Officials designated the same consortium supplying the Tyne engines for the Atlantic to produce the engines for the Transall. As noted earlier, the French firm Hispano-Suiza received 44 percent of the turboprop work as opposed to 28 percent for Maschinenfabrik Augsburg-Nurnberg (MAN).²⁶

The division of work had not been easy; time consuming disputes arose among officials. Negotiators only gradually solved the problems. Eventually some solutions involved the transfer of work from one firm to another, a practice that proved costly and delayed progress. Often it was difficult to reconcile the different procedures and working methods of the two industries and governments. Because neither country totally dominated the project, every problem, even one as trivial as the types of rivets, screws, and screwdrivers to be used, resulted in a new round of meetings and negotiations.²⁷

²⁴*Interavia*, September 1960, pp. 1157-1158; December 1963, p. 1908; *Flight International*, April 25, 1968, p. 614.

²⁵*Air Techniques*, March 1965, p. 52.

²⁶*Flying Review International*, June 1965, p. 29; *Interavia*, February 1963, p. 215; *Flieger*, July 1962, p. 254.

²⁷Ziegler (1973), pp. 32-33; *Aviation Week and Space Technology*, June 2, 1969, pp. 113-114; *Interavia*, September 1960, p. 1157.

Table 5

INDUSTRIAL WORK SHARING ON THE TRANSALL	
Company	Equipment or Part
Nord	Entire wing and engine nacelles and certain components
Messier (As sub-contractor to Nord)	Landing gear
Weser	Center fuselage section and horizontal stabilizer
Hamburger	Front and rear sections of fuselage and vertical stabilizer
Blume	Design of tail unit

Officials encountered similar problems on the financial side of the project. The problems of differing accounting methods, currencies, sales taxes, custom duties, etc. proved difficult to resolve. There are some indications that a dispute arose over financing procedures. Apparently at one point early in 1960 the French withheld funding from the project forcing Germany to carry the entire financial burden for a short time. Eventually the two governments agreed to a financing plan providing for quarterly settlements.²⁸

In March 1960, five months after formal approval of the design, France and Germany finally agreed on a formal schedule and contract for the Transall development program. The contract provided for a fixed price budget of DM 95 million for the construction of three prototypes for flight testing and two complete airframes minus engines for static and fatigue testing. Later officials also negotiated a contract for the construction of six preproduction aircraft. Officials allocated the final assembly of prototypes as shown in Table 6.

All flight testing and the fatigue testing of the fifth airframe would take place in France first under Nord supervision and later under the direction of a Franco-German flight test committee at a joint flight test center to be established at Istres. The first prototype was expected to be completed in mid-1962.²⁹

THE DEVELOPMENT PROGRAM

Actual work on the first prototype did not begin until October 1960, seven months after the participants signed the contract. Much time had been wasted as the various Transall committees attempted to work out compromises on every conceivable issue.³⁰ As late as 1962, negotiators still had not resolved the problem of whether the auxiliary turbojets should be mounted on the German Transalls. As

²⁸*Interavia*, February 1963, p. 215; September 1960, p. 1157. Ziegler (1973), pp. 32-33; *Aviation Week and Space Technology*, June 2, 1969, pp. 113-114.

²⁹*Flight International*, April 25, 1968, p. 615; *Aviation Week and Space Technology*, June 10, 1963, p. 79; *Interavia*, February 1963, p. 215.

³⁰As an example of the many program changes that caused delays, Weser eventually built the third airframe for static testing, and Hamburger built the fourth airframe, redesigned V3, for flight testing.

Table 6

FINAL ASSEMBLY OF PROTOTYPES

First prototype (V1)	Nord
Second prototype (V2)	Weser
Third prototype (V3)	Hamburger
Fourth airframe for static testing (V4)	Weser
Fifth airframe for dynamic loading tests (V5)	Hamburger

a consequence of such problems, the development schedule almost immediately began to slip.³¹

Prototype V1 first flew on February 25, 1963, about eight months behind schedule. C-160V2, built by Weser at Bremen, first flew on May 25, 1963 and the V3 built by Hamburger flew on February 19, 1964, both also substantially behind schedule. Outside of a problem with the horizontal stabilizer, flight testing revealed only minor problems. However, officials decided to stretch production Transalls by 20 inches because of results from wind tunnel tests. On the whole the flight testing program progressed satisfactorily.³²

Politics Disrupt the Program

The year 1963 witnessed a deterioration in Franco-German relations as increased efforts by the Kennedy Administration to reinforce transatlantic links caused Bonn to reassess its attitudes toward Washington and Paris. Adenauer had turned increasingly to de Gaulle in defense collaboration after 1960 because of uncertainties about U.S. commitment to the nuclear defense of Europe. De Gaulle's unilateral veto of U.K. entry into the Common Market in January 1963, U.S. promotion of the Multilateral Nuclear Force, and President Kennedy's renewed strategic nuclear commitment to the defense of Germany offered during his June visit to Europe led the German government to view the strengthening of transatlantic ties as its first priority. This change in orientation soon affected armament collaboration policies. Although de Gaulle personally discussed with German officials the collaborative development of a helicopter and VTOL aircraft, nothing came of these proposals. Instead, the Transall program came under massive attack in Germany and was nearly canceled. In addition, the Germans unilaterally withdrew from a joint tank procurement venture with France and signed an agreement to develop a main battle tank in collaboration with the United States. Later Germany agreed to codevelop a VSTOL aircraft with the United States.

³¹*Aviation Week and Space Technology*, June 2, 1969, p. 113; *Interavia*, January 1962, p. 66; Carlier (1979), p. 144.

³²*Interavia*, September 1960, p. 1157; January 1962, p. 66; February 1963, p. 215; December 1963, pp. 1909-1910; *Aviation Week and Space Technology*, June 10, 1963, pp. 78-79; *Flight International*, April 25, 1968, pp. 615-616; *Flight Review International*, May 1963, p. 17.

The crisis over the Transall developed when the Germans appeared to be moving once again toward adoption of the C-130. In May 1963, the German government had publicly announced its intention to buy 110 Transalls. The French government also stated that it intended to procure at least 50 of the aircraft. Yet the German announcement was only a statement of intent; the Bundestag had to approve the decision. At this point the schedule slippage and cost growth of the development program, Luftwaffe dissatisfaction with the aircraft, an impending change of government in Bonn, an intensified U.S. arms sales drive, and a U.S. diplomatic offensive to counter the recently signed Franco-German friendship treaty all combined to put the Transall project in serious jeopardy.³³

In 1963 the German northern group grew increasingly concerned over the schedule slippage in the Transall program. Industry officials expected the completion of the F-104G Starfighter program in 1964, so Weser and Hamburger feared that a major gap in production work would result. Observers predicted a 25 percent drop in production activity in the industry as a whole by the end of the year. By early 1963, the two German Transall firms were already laying off workers.³⁴

The northern group responded enthusiastically to a new Lockheed offer for the licensed production of the C-130E Hercules. Early in 1963 Lockheed again launched a large-scale European sales campaign. This effort coincided with Secretary of Defense McNamara's establishment of a formal program to promote U.S. military exports. The Defense Department had organized a team of officers in the office of International Logistic Negotiations to aid such sales drives aimed at Germany. Thus both German industry and government circles were subjected to intensive lobbying efforts.³⁵

The emergence of a more pro-American faction on the German political scene, increasing difficulties with France, and U.S. attempts to exploit these events aided Lockheed's efforts. Chancellor Adenauer, who had "a basic and constant preoccupation" with Franco-German rapprochement,³⁶ had agreed to step down from office in the fall. His heir apparent, Dr. Ludwig Erhard, believed in a more balanced approach toward France. In addition, Franco-German relations had been steadily deteriorating since the signing of the friendship treaty in January. The greatest blow had come on January 14 when de Gaulle vetoed Britain's membership application to the Common Market.³⁷ These political developments soon affected German weapons collaboration policies. Six years earlier the French and Germans had agreed "to produce in common" a battle tank within the context of the WEU tripartite arms pool. In July 1963, the German government scuttled the project by announcing that it would adopt the German Leopard tank no matter what the outcome of a joint evaluation. Then on August 2, following visits by President Kennedy and Secretary of Defense McNamara, Germany announced the signing of a Memorandum of Understanding (MoU) for the joint development of a new main battle tank with the United States.³⁸

³³*Interavia*, January 1962, p. 66; February 1963, p. 215; *Flight International*, April 25, 1968, p. 615; *World Aerospace Systems*, May 1969, p. 9.

³⁴*Interavia*, June 1963, pp. 828-831, December 1963, p. 1909.

³⁵Vandevanter (1964), pp. 64-65; Beer (1969), pp. 145-146, 302, n. 36; *Interavia*, December 1963, p. 1909.

³⁶Grosser (1965), p. 476.

³⁷Richardson (1966), pp. 68-72; Grosser (1965), pp. 481-483; *New York Times*, July 6, 1963, p. 1.

³⁸Vandevanter (1964), p. 57; *New York Times*, August 13, 1963, pp. 1, 12; August 18, 1963, Sec. IV, pp. 4, 6.

Against this background Lockheed intensified its lobbying efforts on behalf of the C-130E. The U.S. firm took the unusual step of taking its case for the C-130E to the German public. Hercules sales people also lobbied the Bundestag. The German parliament, partly for political reasons, responded favorably to Lockheed's arguments that licensed production of the Hercules would provide Germany with a higher performance, cheaper transport in less time. Finally, on October 10, the Lockheed campaign seemed to have achieved its objective. The Bundestag Defense Committee refused to approve funds for the Transall program. In addition, the Committee requested comparative testing of the Hercules by Luftwaffe pilots.³⁹ This decision proved to be politically untenable, however.

French irritation with Germany had reached serious proportions requiring some conciliatory gesture toward de Gaulle. This was especially true because Germany required French cooperation on the upcoming negotiations on financing a joint agricultural policy for the EEC.⁴⁰ In addition, the new Defense Minister, Kai-Uwe von Hassel, deeply resented Lockheed's sales methods. In his view the U.S. firm had acted unethically by going over the head of the Defense Minister and directly lobbying the Bundestag during a period of government transition.⁴¹

Finally, the Gaullist faction in the Bundestag and Cabinet had received a boost immediately following Adenauer's resignation when the United States made a practice airlift of an entire army division from Texas to Germany. The airlift came on the heels of a speech by the U.S. Deputy Secretary of Defense advocating reductions of the U.S. military presence in Germany. These events aroused widespread fear of major U.S. troop cutbacks and strengthened the position of those Bundestag deputies who argued that European security depended on close Franco-German collaboration. The crisis reached its peak between October 21 when German newspapers, politicians, and Defense Ministry officials demanded a clarification of U.S. policy and October 25 when Secretary of State Dean Rusk personally assured Chancellor Erhard and Defense Minister Von Hassel that the United States was not contemplating cuts in troop levels. The Bundestag Defense Committee reversed its position on October 23, recommending procurement of the Transall and withdrawing its request for comparison flight testing with the C-130E. The spectre of U.S. troop withdrawals and French political opposition unquestionably contributed to this decision.⁴²

On the industry level, the northern group had also been won back over to the Transall. Industry officials became convinced that because of political problems, licensed production of the Hercules would result in an even larger production gap than a continuation of the Transall program. Thus, industry representatives were generally pleased with the final Bundestag decision and the official government commitment to purchase 110 Transalls announced in December 1963.⁴³

³⁹*New York Times*, November 1, 1963, p. 5; *Interavia*, December 1963, p. 1908; *Flight International*, April 25, 1968, p. 615.

⁴⁰Kulski (1966), pp. 210-219; *New York Times*, October 19, 1963, pp. 1, 24.

⁴¹*New York Times*, November 1, 1963, p. 5; *Economist*, December 7, 1963, p. 1096.

⁴²*New York Times*, October 22, 1963, pp. 1, 4; October 23, 1963, pp. 1, 16; October 26, 1963, pp. 1, 5; Willis (1968), pp. 329-330.

⁴³*New York Times*, December 27, 1963, p. 46; *Interavia*, December 1963, p. 1909.

COMPLETION OF DEVELOPMENT AND PRODUCTION ARRANGEMENTS

The official German commitment to procure the Transall ended the uncertainty that had surrounded the program for much of 1963. Further delays were soon encountered, however, as negotiators struggled to agree on acceptable production arrangements. These were compounded by minor technical problems that continued to plague the project, further shifting of work responsibilities, the inability to win third country sales, financial problems, and more political difficulties.

Negotiators spent much of 1964 negotiating new worksharing and financial arrangements for the production phase. Germany demanded a much larger share of the production work and final assembly lines in Germany because of the size of its projected buy. Officials eventually decided to reallocate work by value according to the 50/110 ratio of buys. This gave Germany approximately 64 percent of the work by value. To facilitate this change, Nord was forced to transfer work on the wing center section to Messerschmitt and Siebel after the completion of the 13th aircraft. For purposes of expanding its aerospace capabilities, Germany insisted on a final assembly line at both the two major German firms' facilities. Thus the two partners agreed to assemble 160 production aircraft on three separate assembly lines. Officials signed the final agreement incorporating these measures on September 24, 1964.⁴⁴

Flight testing continued throughout 1964 and 1965, during which time the three prototypes logged more than 3000 hours flying time. Nord completed the first of six preproduction aircraft early in 1965.⁴⁵ Prototype flight testing was completed by the end of the year. Joint operational flight evaluations of the preproduction aircraft, however, continued for two more years. Although a production contract had been agreed to, it remained unsigned.⁴⁶ Cost and budgetary problems compounded by continued Luftwaffe dissatisfaction and political difficulties stalled the production phase.

By the end of 1963, total development and production cost estimates already greatly exceeded original expectations. The entire R&D program eventually experienced a cost overrun of more than 100 percent, excluding inflation. A lack of third country sales also undermined the program's financial stability. Officials inaugurated an initial sales campaign in 1963 by demonstrating the capabilities of prototypes V1 and V2 at the Paris Air Show. Unfortunately for the Transall, Lockheed also displayed its new C-130E. As one observer noted, the performance of the Hercules "certainly surpassed" that of the Transall.⁴⁷ Such observations plagued the C-160 sales effort from the beginning. The simple fact that Lockheed could immediately provide a comparable aircraft with higher overall performance at a lower unit price undercut the Transall's third country sales prospects. Nonetheless, the two European partners did not abandon their efforts.⁴⁸

Almost from the beginning the Transall partners targeted those countries fly-

⁴⁴*Flight International*, April 25, 1968, p. 616; *Jane's All the World's Aircraft* (1967-68), pp. 89-90.

⁴⁵*Flying Review International*, September 1964, p. 66; *DMS Market Intelligence Reports*, "Transall C-160," October 1967, pp. 3-4.

⁴⁶*Flying Review International*, September 1964, pp. 65-66; *Jane's All the World's Aircraft* (1970-71), p. 124.

⁴⁷*Flying Review*, August 1963, p. 16.

⁴⁸Wood (1975), pp. 225-231; *Flight International*, April 25, 1968, p. 617.

ing the Noratlas 2501 for their sales drive. Because the C-160 had been adapted for a hot climate and possessed greater STOL characteristics from a poorly prepared strip than the Hercules, the consortium also hoped to sell the aircraft to equatorial or third world nations. No European or third world sales materialized, however.⁴⁹

Eventually, U.S. export restrictions permitted the consortium to win its one third-country export sale. The government of South Africa planned to increase its fleet of C-130s with a purchase of more of these aircraft. The United States, however, blocked the sale because of a United Nations resolution banning the sale of military equipment to the South African regime. Consequently, in mid-1966, the South African government decided to fill its requirements by ordering nine Transalls, the only available aircraft comparable to the Hercules.⁵⁰

Engineers designed several Transall civil variants in hopes of stimulating exports. Some European airlines expressed interest in these proposals, but most determined that the Lockheed L-100, the civil version of the Hercules, offered superior performance at less cost. Thus, no airlines placed orders for any of the proposed Transall civil versions.⁵¹

THE 1967 PROCUREMENT CRISIS

The failure to win third country orders combined with serious cost overruns during a period of increased budgetary restrictions led to another political crisis in the Transall program. The fundamental cause was a recession in Germany requiring a major cutback in projected German defense expenditures. The Transall's poor record in terms of cost overruns, schedule, and foreign sales made the program vulnerable to attack.

Early in 1967 the new German government of Kurt Kiesinger committed itself to a \$500 million cut in defense spending over the next three years because of the deepening recession.⁵² The armed forces had to reexamine their equipment procurement priorities and decide which programs could be cut back or canceled with the least damage to national security. For the Luftwaffe, the Transall stood out as the most obvious target for attack. First, the Luftwaffe needed its limited procurement funds to purchase Starfighter replacements, and the United States had been exhorting the Germans for some time to buy the McDonnell-Douglas F-4 Phantom to fill that role. Second, the German air force had never been satisfied with the Transall, an aircraft designed primarily to meet French requirements. Third, the army urged the air force to procure medium helicopters instead of C-160s for battlefield logistical support, because the Transall had unsatisfactory STOL capabilities. The Luftwaffe therefore requested a reduction of at least 50 aircraft in the original Transall order for 110 aircraft in order to economize. This solution

⁴⁹*Flying Review International*, September 1964, p. 65; *Aviation Week and Space Technology*, September 18, 1967, p. 31; *Flight International*, April 25, 1968, p. 617.

⁵⁰*Flying Review International*, June 1966, p. 604; *Flight International*, April 25, 1968, p. 617.

⁵¹*Interavia*, November 1963, p. 1913; April 1967, p. 460; *Aviation Week and Space Technology*, June 19, 1967, p. 34; *DMS Market Intelligence Reports*, "Transall C-160," October 1967, p. 3; November 1972, p. 2.

⁵²Morgan (1973), pp. 172-173; Grosser (1974), pp. 187-189.

seemed reasonable to all interested parties except two: the French government and the German aerospace industry.⁵³

The French government vigorously protested the Luftwaffe request. A reduction by one-third of the total production run would significantly increase unit costs. It would also be perceived as a political setback to one of the most visible symbols of Franco-German entente. The French threatened to invoke a penalty clause, included in earlier agreements, requiring Germany to compensate the French for the higher unit cost of their aircraft. The German aerospace industry, led by VFW (formerly Weser), also strenuously objected. Their studies showed that a reduction of 50 aircraft in the German order would result in only 10 percent cost savings because of higher unit costs, compensation payments to the French, and because parts for 145 aircraft had already been completed. Since the Transall program represented the single largest production project currently planned, the German aerospace industry put considerable pressure on the Bundestag to confirm the original order for 110 aircraft.⁵⁴

In September, officials arranged a compromise that satisfied everybody except the Luftwaffe. The Bundestag Defense Committee approved the original German production order for 110 Transalls, ending the possibility of a confrontation with France. This was especially important at this time because Germany was on the verge of joining France and the United Kingdom in launching a program to develop a European Airbus. German industry officials expected that Transall production would occupy their industrial capabilities until Airbus production began. This latter project would lessen the industry's dependence on government military orders. The industry did not want to see such a project jeopardized by a conflict with France over the Transall. The German government also supported the industry's efforts to break into the commercial transport market. To meet the Luftwaffe's request for a decreased Transall order, the German government agreed that only 73 of the 110 aircraft would enter into active service; 17 would be held in reserve, economizing on operating costs. In addition, 20 of the Transalls would be sold abroad, recouping some of the procurement costs of the original order.⁵⁵

The Luftwaffe was less than entirely pleased with this compromise. First, the purchase of all 110 Transalls meant a reduction in funds available for procurement of medium-heavy logistics helicopters and Starfighter replacements. Second, the poor sales record of the Transall meant that it would be difficult to find buyers for 20 of the aircraft. Indeed, except for South Africa, no third country customers ever materialized. Late in 1970, after futile attempts to sell the aircraft, the German government finally arranged to transfer the 20 C-160s to the Turkish armed forces under the auspices of a NATO military aid program.⁵⁶

Delayed by political controversy, the first production German C-160 did not fly until near the end of the year. Initial service deliveries to the two air forces took place in April 1968. Production was stretched out through August 1972, about a year longer than originally projected. The need to avoid a production gap and

⁵³New York Times, November 25, 1967, p. 1; *Aviation Week and Space Technology*, July 17, 1967, pp. 40-41; September 18, 1967, p. 31.

⁵⁴*Aviation Week and Space Technology*, September 18, 1967, p. 31; July 17, 1967, p. 41; *Flight International*, April 25, 1968, pp. 616-617.

⁵⁵*Aviation Week and Space Technology*, September 18, 1967, p. 31; July 17, 1967, p. 41; *DMS Market Intelligence Report*, "Transall C-160," October 1967, p. 3.

⁵⁶*DMS Market Intelligence Report*, "Transall C-160," November 1972, p. 2; *Aviation Week and Space Technology*, September 18, 1967, p. 31.

maintain employment until the A-300B Airbus went into full production contributed to the stretchout. By the end of the production program in mid 1972, a total of 178 production aircraft had been manufactured.⁵⁷

SCHEDULE, COST, PERFORMANCE

The Transall C-160 R&D program unquestionably experienced substantial cost overruns and schedule slippage. Most observers admit the program encountered serious cost overruns; the available evidence suggests that it was well over 100 percent excluding inflation.⁵⁸ In addition the actual Transall program took 8.3 years, or about twice as long as expected.⁵⁹ The Transall seems for the most part to have performed up to original specifications. VFW officials claimed in 1967 that all three companies were receiving substantial incentive payments because the aircraft equalled or exceeded all performance specifications except short takeoff from an unprepared field. Although the French probably got the best codeveloped aircraft possible in collaboration with a partner whose original requirements had differed significantly, as shown in Table 7, the Transall still did not match its major competitor in many respects.⁶⁰

Table 7

COMPARISON OF TRANSALL AND HERCULES

	Transall C-160F (French production version).	Hercules C-130H
Maximum payload	35,274 lb	43,811 lb
Range ^a	1,056 mi	2,487 mi
Maximum cruising speed ^a	322 mph	386 mph
Maximum rate of climb ^a	1,300 ft/min	1,900 ft/min
Service ceiling ^a	25,500 ft	33,000 ft
Takeoff run ^a	2,450 ft	3,580 ft
Price range (1972)	\$6.6 - \$7 million	\$3.4 million (C-130E)

^aWith maximum payload.

⁵⁷*Flight International*, August 5, 1971, pp. 211-212; *Aviation Week and Space Technology*, January 3, 1977, pp. 21-22; *Jane's All the World's Aircraft* (1970-71), p. 124; 1977-78, p. 97.

⁵⁸Based on data from *Aviation Week*, June 15, 1959, pp. 55-56; *New York Times*, December 27, 1963, p. 46; *Interavia*, April 1960, p. 481; September 1960, p. 1157; April 1968, p. 44; and Carlier (1979), pp. 74, 104, 144.

⁵⁹*Aviation Week and Space Technology*, September 18, 1967, p. 31; *Jane's All the World's Aircraft* (1960-61), p. 171; *Interavia*, September 1960, p. 1156, January 1962, p. 66.

⁶⁰*Jane's All the World's Aircraft* (1977-78), pp. 98, 335; *DMS Market Intelligence Reports*, "Lockheed C-130 Hercules," February 1974, pp. 1, 3; "Transall C-160," November 1972, p. 1. Gunston (1977), pp. 170-172.

CONCLUSIONS

In terms of cost, schedule, and performance, the Transall program was something less than a success. The project experienced over 100 percent cost growth and schedule slippage, to produce an aircraft that with the possible exceptions of STOL performance, fuel economy, and hot weather flight characteristics is substantially outperformed by the C-130. There are several possible explanations for this outcome, most of them directly related to the dynamics of collaboration:

1. There were serious disagreements among the partners over requirements and specifications. The final joint requirements necessitated major concessions, especially by Germany, resulting in a projected aircraft that was a compromise between diametrically opposed mission concepts. Consequently, the aircraft could not be maximized as either a tactical assault transport or long range heavy transport.
2. The project was inordinately politicized, which contributed to an inherent instability. The entire Transall program was inextricably linked to Franco-German relations, U.S.-German relations, and German domestic politics. France closely associated the project with its foreign policy, which was based on a close relationship with Germany. Germany originally entered the venture and then significantly compromised on requirements, in large measure because of political and industrial considerations. That the aircraft did not clearly meet Luftwaffe requirements made it politically controversial in Germany. The project was seriously disrupted in 1959, 1963, and 1967 when domestic political and economic considerations, or pressure from the United States, worked against the close political association with France. At these times the dissatisfaction of the Luftwaffe, the cost overruns, the schedule slippage, and the lack of third country sales made the project vulnerable to disruption. Yet French diplomacy rendered the project politically immune to cancellation. From this perspective, the French clearly dominated the venture.
3. The venture lacked a unified government and industrial management structure. For a variety of political and economic reasons, France was unable to acquire undisputed project leadership, but she also prevented the Germans from doing the same. This resulted in a totally bilateral management structure similar in many respects to the Concorde or the U.S.-German MBT-70 tank programs. Authority was diffused and the power to veto was widely spread. French advocates of collaboration have often referred to this as the primary cause of the program's difficulties.
4. Both partners ignored the theoretical cost benefits of collaboration. The project's history demonstrates that the key economic considerations at stake were employment and national aerospace capabilities rather than the exploitation of relative economic advantage or the rational pooling of R&D capabilities. The best examples of this were the establishment of three separate assembly lines to produce a mere 178 aircraft and the disruptive transfers of work to achieve *juste retour*.
5. The venture was the first genuine codevelopment aircraft project. Neither the NATO Lightweight Strike Fighter project nor the Atlantic program,

both of which were conducted largely on a national basis, resolved many of the issues relating to genuine codevelopment. Officials thus had to negotiate new agreements for dealing with everything from joint accounting procedures to a politically acceptable division of the work.

Political and industrial factors were of overwhelming importance in the course of the venture. On a purely technical and theoretical level, the project should have presented few difficulties. The aircraft is totally conventional and closely resembles the Hercules, an aircraft developed years before the Transall. The R&D program used the same off-the-shelf engines built under license for the Atlantic. Indeed, Henri Ziegler maintains that the Atlantic was actually a more technically difficult project than the C-160. Although engineers did encounter various technical problems during the course of R&D, none seems to have significantly affected schedule and cost. On a technical level the program was conducted according to the precepts of austerity and incrementalism that have often brought success for French national projects.⁶¹ As the Rapporteur of the Defense Committee of the French National Assembly concluded early in 1963, "This medium transport aircraft will be expensive, as recognized from its inception. The primary quality of this program would appear to be more political than aeronautical."⁶²

Throughout the Atlantic program and during the earliest phases of the Transall venture the participants had at least paid lip service to NATO RSI objectives. By 1964, however, little was being said of these Alliance goals, particularly with respect to the Transall program. Armaments collaboration had clearly become an increasingly useful tool in the Franco-American struggle for political influence with Germany. The political value of the Transall program far outweighed its utility as an efficient and effective acquisition strategy. Its importance as a symbol of Franco-German solidarity and as a challenge to U.S. aerospace and technological ascendancy in Europe ultimately justified its continuation. European nations that placed more emphasis on efficient acquisition strategies, enhanced military capabilities, and the maintenance of strong transatlantic bonds invariably chose the Hercules to fulfill their transport requirements. Yet French diplomacy exercised in conjunction with the Transall venture was instrumental in blocking a European NATO Hercules licensed production program in both 1959 and 1963. As a consequence, European air forces now fly two non-standardized aircraft with the same functions.

Although the Transall program neither promoted NATO RSI objectives nor represented a particularly efficient acquisition strategy, it did advance the regional political and national industrial aims of the participants. It became one of the largest aerospace research, development, and production programs in both Germany and France in the 1960s. Perhaps more important from the European perspective, it sustained and furthered Franco-German large-aircraft design, development, and production capabilities in anticipation of the most dramatic European collaborative assault to date on U.S. aerospace hegemony, the A-300B Airbus program.

⁶¹See Perry (1973).

⁶²Joel Le Theule, quoted in Carlier (1979), p. 144.

IV. THE AIRBUS

The increasingly restrictive military budgets of the mid-1960s encouraged the French, British, and German governments to support the collaborative development of competitive commercial transports as a more economical means of maintaining national aerospace capabilities and employment. The financial burden of procuring civil aircraft is carried by commercial or at least semi-commercial air transport companies rather than by the armed forces. Individual European firms could or would no longer accept the enormous financial and technological risks necessary to launch a major civil aircraft program on their own, but austere budgets made it difficult for governments to underwrite civil aircraft projects on a purely national basis. In addition, a growing number of European observers argued that successful competition with the United States required the international pooling of R&D resources and funding.¹

The 1962 Anglo-French Concorde Treaty ushered in an era of collaboration on major civil aerospace projects in Europe. To many Europeans the Concorde supersonic transport program represented a crucial first step in overtaking the enormous U.S. lead in civil aircraft. U.S. firms had dominated the world commercial airline market since World War II, supplying 98 percent of American and 90 percent of European needs. By combining their aerospace capabilities, Britain and France hoped to put a high-technology supersonic transport on the market first, thus helping Europe undermine, in de Gaulle's words, "American colonization of the skies."² Despite the many difficulties encountered in the program, the Concorde example encouraged the view that through collaboration Europe could more successfully challenge U.S. domination of civil aviation.³

Besides spreading the financial risk and consolidating aerospace resources to compete on a more equal footing with the United States, collaboration seemed to offer the advantage of extending the market and limiting the competition within Europe. Advocates of collaboration argued that an aircraft built by a consortium with government funding would enjoy a guaranteed market with the flag carriers of the participating nations. This would neutralize parochial European national rivalries, shut out the Americans, and allow for a profitably long production run. It was also hoped that participants would combine their marketing and diplomatic resources more effectively to sell the plane abroad in competition with U.S. aircraft.⁴

The Europeans broadened their challenge to the U.S. commercial aircraft industry in 1965 by launching a collaborative program to develop a European entry in the newly proposed category of wide-body large capacity civil transports, commonly referred to as airbuses or jumbo jets.⁵ The Airbus venture may be divided

¹*Multinational Business*, "A New Era in Aerospace Joint Ventures," No. 2, 1976, p. 7; Costello and Hughes (1976), pp. 286-287.

²Costello and Hughes (1976), p. 41; *Business Week*, May 6, 1972, p. 64.

³Ziegler (1973), pp. 35-36; *Le Monde*, April 25, 1979, p. 45.

⁴*Multinational Business*, No. 2, 1976, p. 7; *Business Week*, May 6, 1972, p. 64.

⁵The airbus concept evolved on both sides of the Atlantic in the early 1960s as a response to growing congestion of the airways and airports on the heavily traveled routes between major cities. As early as

into two distinct phases. The first phase (A-300), from 1965 to 1968, was characterized by laborious negotiations among the French, British, and Germans over industrial and diplomatic tradeoffs while commercial and cost-effectiveness factors were ignored, in a manner similar to the Transall venture. At the end of this phase, Britain withdrew from the project leaving the French and Germans with a proposed aircraft that no airline would order. The French had encountered major difficulties in imposing their leadership on the United Kingdom because of the latter country's growing disillusionment with the Concorde and Britain's fairly strong industrial position with respect to commercial transport development capabilities, and because of de Gaulle's veto of Britain's second attempt at EEC membership. In the second phase of the venture (A-300B), from 1969-1974, the French more easily dominated the program because Germany and the other participants in this area of aerospace R&D were fairly weak. In addition, the demands of the market caused the participants to radically lessen the emphasis on national industrial considerations in order to ensure that the aircraft would be commercially viable.

THE A-300 AIRBUS, 1965-1968

Origins

With the exception of the Concorde, French aerospace and weapons development collaboration before 1965 had been primarily a bilateral affair with Germany. Although more than willing to provide aircraft engines for the G91, Atlantic, and Transall, the British had remained generally aloof from continental aircraft collaboration projects. In late 1964, however, the attitude of the United Kingdom toward collaboration changed with the installation of a new Labour government saddled with a balance of payments crisis and severe inflation. The new Prime Minister, Harold Wilson, was determined to slash government spending on aerospace projects while strengthening ties with Europe in order to support a second EEC membership bid. These goals would be well served, it was thought, through a general policy of aerospace collaboration with France. Although in many ways the originator of European codevelopment, France had always proceeded ad hoc, carefully examining each proposed project and choosing only those that maximized its own perceived national industrial and political objectives. In contrast, the British government in 1965 canceled nearly all of its most important national aerospace projects and began carrying out a general policy of aerospace collaboration to advance its national industrial and diplomatic objectives.⁶

The new British initiatives toward France met with a warm reception. De

1961 airlines expressed interest in the development of wide-body, large capacity transports permitting high-density seating to reduce air route congestion and lower passenger seat-mile costs. The introduction of more powerful and efficient turbofan jet engines made such an aircraft even more desirable and feasible. Kuter (1973) pp. 2-5.

⁶See *Report of the Committee of Inquiry into the the Aircraft Industry*, London, December 1965; Webb (1969), pp. 581-592; Costello and Hughes (1976), pp. 86-100, 105; *Aviation Week and Space Technology*, February 15, 1965, p. 23; April 12, 1965, pp. 26-27; *Economist*, March 22, 1969, p. 87; Wood (1975), p. 179; Burt (1975), pp. 5-6.

Gaulle viewed the situation as a further means of aiding the French aerospace industry while weaning the United Kingdom away from its "special" relationship with the United States. Franco-German relations had become increasingly strained in 1964 as the new Erhard government continued to press for closer defense ties with the United States. The slowing pace of Franco-German military collaboration and the continuing difficulties with the Transall venture reflected this stress. In July de Gaulle met Erhard in Bonn to urge the Germans to step up Franco-German cooperation. Although agreeing to remain in ongoing programs, Erhard's government strongly reaffirmed its primary orientation toward NATO and the United States.

Franco-German relations continued to deteriorate throughout the fall of 1964 as the Federal Republic signed an accord with the United States for large-scale military purchases and increased armaments collaboration. As de Gaulle's vision of a French-led Europe centered on a Franco-German bloc faded throughout 1964 the French became increasingly receptive to new offers of collaboration from the British. De Gaulle's vision included a role for Britain if and when the United Kingdom would loosen its defense links with the United States. Finally, substantial cost overruns on the development of the French strategic nuclear force made it more difficult to fund all desired projects on a national level.

Budget limitations drove the French as much as the British toward collaboration on an airbus. In 1961 Air France asked the government to fund the development of an airbus to replace its Caravelles in the early 1970s. By mid-1964 Sud Aviation had publicly revealed its proposed 241 passenger Galion, designed to meet Air France specifications, but the proposal did not receive government funding. The government could financially underwrite the project only if the national development costs were decreased by launching the Galion as a collaborative venture. Thus, in the initial discussions with the British early in 1965, the French advanced the Galion as the basis for a collaborative airbus project.⁷

Early in 1965 Wilson and de Gaulle met and examined a comprehensive new list of possible collaborative projects, including a trainer/strike fighter, a variable geometry aircraft, and an airbus. The British did not accept the French Galion proposal outright. Instead, in a Memorandum of Understanding signed on May 17, 1965, the two countries agreed to commission a joint design study. The MoU called for the establishment of a joint committee to study market potential and broad technical requirements. British and French firms could submit design proposals to the committee. Final evaluation would take place on the ministerial level.⁸

German government and industry circles watched these developments with growing interest. In June Franco-German industrial meetings began. On July 2 several German aerospace firms brought their efforts together into an informal airbus study group (Studiengruppe Airbus). Technology acquisition and the hope of breaking into the commercial sector of the aircraft industry attracted Germany. Germany also needed a large aircraft program to maintain employment after Transall production wound down.⁹ From the British and French perspective, inclusion of Germany would provide a new and significant source of development

⁷ *Aviation Week and Space Technology*, July 13, 1964, p. 27; October 16, 1964, p. 268.

⁸ *Aviation Week and Space Technology*, July 5, 1965, p. 24; May 24, 1965, p. 18.

⁹ *Flight International*, November 23, 1967, p. 882; *Air Enthusiast*, August 1972, p. 67.

funds and an expansion of the "assured" market without the necessity of relinquishing too much control over the program. Germany officially joined the design study for a European airbus in February 1966.

For well over two years after the initial MoU, the interested government ministries, flag carriers, and airframe and engine manufacturers of the three participating nations promoted their own interests in the initial negotiations to determine joint specifications, design leadership, work allocation, funding responsibilities, production arrangements, and program management. These negotiations proved to be extremely difficult and complex. The participants all attempted to maximize their own perceived national, economic, or commercial interests. Negotiators seemed to be little concerned with industrial rationalization, relative economic advantage, or any other possible means of achieving cost effectiveness through collaboration. The content of the airbus program evolved out of a series of essentially political compromises. The negotiators appeared to be peculiarly unconcerned with the commercial and cost implications of these compromises, which, in the end, seriously undermined the likelihood the project would succeed.

The Airframe Competition

French and British authorities established a joint evaluation committee by the summer of 1965, but they neglected to establish any formal organizational structure or procedures for some time. French, British, and German firms opened negotiations to explore the possibility of joint design efforts. By early 1966 Hawker-Siddeley had begun discussions with Breguet and Nord Aviation while British Aircraft Corporation (BAC) talked with Dassault and Sud. The previous June Breguet and Nord signed an agreement to merge their early design studies into a joint development effort. As the likelihood of German participation increased late in 1965, several German firms also decided to coordinate their efforts more formally. On December 23 the German Transall firms (Messerschmitt, VFW, Siebelwerke, and Hamburger) and Dornier established the German Airbus Working Group (*Arbeitsgemeinschaft Airbus*).¹⁰

In an attempt to accelerate the design evaluation process, representatives from Air France, Alitalia, British European Airlines (BEA), Lufthansa, Sabena, and SAS opened technical meetings in Paris and London to draw up common specifications. Air France attempted to dominate the meetings, but BEA in particular resisted. By October 1965 the meetings produced common specifications similar to those of the Galion for a 200-250 passenger 900-1200 mile range, 550 mph jet transport powered by two turbofans beneath the wings, ready for certification in 1971 and delivery in 1972. BEA refused to approve these specifications and other carriers were less than pleased with them.¹¹

Actually BEA and BAC (later, BAe) had been unhappy with the airbus project nearly from its inception. BEA wanted a smaller (150-200 seat) airbus, and perhaps even more important, it wanted a British-built airbus. BAC agreed entirely. Its discussions with Sud and Dassault went badly. The British carrier's rejection of the

¹⁰*Aviation Week and Space Technology*, May 9, 1966, p. 28; July 5, 1965, p. 24; Gianni (1971).

¹¹*American Aviation*, September 1966, p. 89; *Air Enthusiast*, August 1972, p. 68.

joint specifications finally led BAC to withdraw altogether from the multinational industrial discussions. The company then went ahead and proposed a purely national project, the BAC-211, tailored to fit BEA's requirements. French government and industry circles objected to these developments, arguing that the 211 would be a direct competitor to a European airbus. This episode imposed serious strains on the trinational negotiations, especially because BAC began to lobby the British government for startup funding for its airbus.¹²

For their part, the German firms backed an airbus concept different from both the BAC/BEA and Sud/Air France designs. The Airbus Working Group favored a 300 passenger, four engine transport. Lufthansa, however, showed little interest in any of the designs. The German flag carrier operated only Boeing aircraft and expressed no great interest in change.¹³

Early difficulties with Lufthansa and BEA were harbingers of more serious problems to come. The assumption that a collaborative European airbus would be supported by the collective purchasing power of the national flag carriers was already proving to be incorrect. Management ran the flag carriers on a more-or-less profit-making basis and was not always necessarily concerned about the interests of either foreign or domestic aerospace industries. It proved much more difficult to bring the flag carriers into line than originally expected.¹⁴

Despite these difficulties, industrial negotiators finally recorded some progress by the spring of 1966. Although BAC had left the negotiations, Hawker-Siddeley developed a satisfactory working relationship with Breguet and Nord. The three firms collaborated on a 250 passenger HBN 100 airbus design. By May 1966 the Sud Galion and the HBN 100 had become the two prime contenders in the airframe competition. The HBN 100 closely resembled the Sud Galion and was roughly equal in technical merit. However, because the French government favored Sud as the design leader,¹⁵ Hawker-Siddeley opened negotiations with that firm in September.¹⁶

Despite Hawker-Siddeley's good working relations with French firms, inter-governmental negotiations nearly broke down in 1966. BAC and BEA, now nearly in open opposition to the collaborative project, increased pressure on the British government to fund the BAC-211. Concurrently a new controversy over the engine for the airbus nearly wrecked the program. Yet in the end that controversy provided an opportunity for compromise on the airframe.

The Engine Competition

Since the outset of negotiations the French government, backed by Germany, had argued that the airbus should be equipped with Pratt and Whitney JT9D turbofans produced under license by SNECMA¹⁷ and Bristol Siddeley. Rolls-Royce

¹²Hayward (1976), p. 360; *American Aviation*, September 1966, pp. 90-91.

¹³*Aviation Week and Space Technology*, May 6, 1966, p. 26; *Flight International*, November 17, 1966, p. 837.

¹⁴Reed (1973), p. 119.

¹⁵Breguet and Nord were still occupied with the Atlantic and Transall.

¹⁶*Aviation Week and Space Technology*, May 9, 1966, p. 27; *American Aviation*, September 1966, p. 88; Gianni (1971), p. 428.

¹⁷Société Nationale d'Étude et de Construction de Moteurs d'Aviation.

had induced the British government to support its RB.207. The conflict originated in differing perceptions of national self-interest.

Rolls-Royce probably possessed more expertise in advanced engine technology than any other European firm. The French, however, did not want SNECMA relegated to the status of a subcontractor to Rolls-Royce. In their view, licensed production of the JT9D with Bristol Siddeley would allow French industry to acquire advanced American technology while maintaining a more equitable relationship with its British partner. In addition, SNECMA had collaborated with Pratt and Whitney for years; its tooling was designed specifically to accommodate the U.S. firm's fabrication techniques. Finally, the French advanced a compelling economic argument for the JT9D. In 1965 this engine had been chosen by Boeing for the initial production of the B-747, substantially lowering its development costs for the Europeans. The Germans supported the French position because Lufthansa flew an all Boeing fleet powered by Pratt and Whitney engines.¹⁸

Boeing's choice of the JT9D for the 747 strengthened the French position, but at the same time made Rolls-Royce more intransigent. Rolls had fought hard to win the engine contract for the 747. When it lost out to Pratt and Whitney, the European airbus became the only on-going program available for the RB.207. The British government so valued Rolls-Royce as a national technological and economic asset that it quickly adopted the company's technological and financial goals as its own. By 1966 the British were insisting in negotiations with the French and Germans that the RB.207 must be designated as the power-plant for the airbus.¹⁹

Government level negotiations completely deadlocked over this issue in the spring of 1966. But in September, Bristol Siddeley merged with Rolls-Royce, fatally undercutting the French position. The British allowed this license option on the JT9D to lapse that December. The French unenthusiastically accepted the RB.207 for the airbus. This concession, however, permitted them to push more forcefully for airframe design leadership. In addition the French increased pressure on the U.K. government to refuse startup funding for the proposed BAC 211. Eventually the British acquiesced.²⁰

The Engine and Airframe Compromises

The RB.207 was chosen for the airbus not because it was the best choice economically, commercially, or technologically, but because its choice had become a prerequisite to British participation. France and Germany much preferred the JT9D or even the General Electric CF6-50, both of which entailed little risk because they were already being developed for other aircraft. Both U.S. and European observers correctly doubted Rolls' ability to develop the RB.207 in a reasonable period of time.²¹ The choice of the British engine, a purely political decision that would significantly increase development costs and risks, may be singled out as one

¹⁸ *Aviation Week and Space Technology*, May 9, 1966, p. 28; *American Aviation*, September 1966, p. 90; Hayward (1976), p. 364.

¹⁹ Hayward (1976), pp. 358-359.

²⁰ *Aviation Week and Space Technology*, November 7, 1966, p. 47.

²¹ Kuter (1973), p. 9.

of the most important factors contributing to the cost overruns and schedule slippage that undermined the original A-300 project.

After the concession of engine design leadership to Rolls-Royce, French interests prevailed on the airframe design. Sud Aviation won airframe design leadership, but the governments selected the HBN 100 rather than the Sud Galion as the starting point for further design definition, because Hawker Siddeley had been so closely associated with the former proposal. In essence the British government had decided to sacrifice the interests of BAC and BEA to those of Rolls-Royce. In November 1967 the government killed BAC's proposed national project by denying funding for the BAC 211.²²

The U.K. government's decision outraged vocal segments of the British airframe industry. The French had already secured airframe design leadership on the Concorde and Jaguar. Critics again accused the government of capitulating to the French for dubious political gains such as entry into the Common Market. BAC and BEA never genuinely accepted the airframe compromise and the cancellation of the BAC-211. Their hostility toward the European airbus was a second major factor that eventually wrecked the A-300 program.²³

Size and Cost Growth

By the beginning of 1967 the engine and airframe compromises had been reached. The designated firms then set out to refine their design studies in anticipation of an official government go-ahead for a final design definition phase. During this period, the first half of 1967, the major European air carriers became increasingly disenchanted with the European airbus.

BEA and Lufthansa skepticism toward the project deepened as the proposed airbus grew in size and cost. By May the airbus had increased from an original planned capacity of 250 passengers a year earlier to a proposed capacity of 300-350. Estimated development costs rose over the same period from \$300 million to \$364 million. This enlargement in capacity was an attempt to make the airbus more directly competitive with proposed American airbuses. Thus in 1967 the design teams began ignoring the preferences of the participants' airlines, including Air France. Consequently, the participants' airlines lost any interest in the project they may have had. The inability to obtain orders for the airbus after this point crippled the program and ultimately provided a rationale for Britain's withdrawal.²⁴

With the major compromises hammered out, the initial concept and design study phase moved rapidly toward completion. At the end of June 1967 the three national industrial groups presented to their governments their final project plans for the design and development of a large capacity short/medium range transport now designated the A-300 Airbus. These plans were approved by July 25. The three governments formally agreed to begin a final government funded design definition phase in September.

²²*Aviation Week and Space Technology*, February 12, 1968, p. 33; November 7, 1966, p. 47; Hayward (1976), p. 360.

²³*Flight International*, August 17, 1967, p. 251.

²⁴*Aviation Week and Space Technology*, October 2, 1967, p. 30; May 6, 1966, pp. 26-27.

The Anglo-French-German Memorandum of Understanding, September 27, 1967

The September 1967 MoU seems to have been influenced considerably by the difficulties experienced with the Concorde project and during the lengthy initial negotiations over the airbus. It was a much more cautious document than the Concorde Treaty signed in 1962. The MoU did not authorize a final go-ahead for an A-300 development program. Rather it committed the three signatories only to finance a 12-month final design definition phase (July 27, 1967, through July 31, 1968). During this period the designated firms would complete their advanced design studies, calculate precise development cost estimates, and present the final design to major airlines for their approval. The MoU also indicated the work sharing, management, and financial arrangements for the development and production of the aircraft.²⁵

Costs, Financing, and Work Sharing. Total research and development costs, including the construction of four test aircraft and two test airframes, were estimated at 532 million 1967 dollars, \$364 million for the airframe and \$149 million for the engine. The three governments agreed to pay the entire bill. They were to be paid back from the sales of the aircraft. The MoU divided financial responsibility and work sharing according to the formula in Table 8.²⁶

Table 8

FINANCIAL CONTRIBUTION AND WORK
(In percent)

Country	Airframe	Engine
France	37.5	12.5
United Kingdom	37.5	75
Germany	25	12.5

Industrial Management and Work Sharing. The Airbus MoU attempted to minimize those difficulties in the Concorde and Transall programs perceived as stemming from the unnecessary complexity of the international organizational arrangements and wasteful duplication in the development effort. As in the Atlantic project, the MoU designated a genuine "pilot firm" or prime contractor for the development of the airframe and engine. The Concorde Treaty had divided development responsibility equally through the use of separate national contracts. For the A-300 there would be only one contract for the airframe, awarded to Sud, and one for the engine, awarded to Rolls-Royce. These two firms would subcontract work according to the work sharing agreement. No international industrial management organization was established. The only organizational consolidation took place on the national level when the German Airbus Working Group incorporated as a

²⁵Gianni (1971), pp. 404-405.

²⁶*Aviation Week and Space Technology*, October 2, 1967, p. 30; *Economist*, June 29, 1968, p. 69; Gianni (1971), p. 407.

consortium called Die Deutsche Airbus GmbH. For the purposes of coordinating development and production on the industrial level, the MoU suggested a simple and informal structure of ad hoc international committees.²⁷

For the series production phase the signatories set forth a single-source component policy to avoid duplication. Sud would construct the fuselage from the rear of the wing mountings forward, Deutsche Airbus the rear fuselage and tail assembly, and Hawker-Siddeley the wings. The MoU envisioned only one final assembly line located at Toulouse. Contracting philosophy stressed the use of existing components and technology. Every effort was to be made, however, to buy only from European sources.

Government Oversight. The MoU assigned direction of the A-300 program to a Management Committee composed of government representatives from the participating nations. An Executive Committee would carry out the decisions of the Management Committee. But during the final design definition stage, government oversight was based on a fairly uncomplicated ad hoc arrangement whereby the various government ministries of each country evaluated design and cost studies prepared by industry. The technology or economics ministers of each country met at irregular intervals to make the key decisions.²⁸ Finally, all three governments agreed to persuade their national airlines each to place startup orders for 25 A-300s and oppose the purchase of any aircraft directly competitive with the Airbus.²⁹ This provision proved impossible to enforce.

Cost Growth, Schedule Slippage, and British Withdrawal

After nearly two and a half years of painstaking negotiations, Britain, France, and Germany had finally agreed to fund a detailed design definition study for a European airbus. The MoU described the A-300 as a 300-350 passenger, Mach .85, short/medium haul transport powered by two RB.207 engines mounted beneath the wings. Yet one insurmountable obstacle still stood in the way of the program: No airlines, not even the participants' flag carriers (with the possible exception of Air France), were willing to order the proposed aircraft. Because industrial and political considerations had played a more important role in shaping the A-300 than airline requirements, most European carriers were dissatisfied with the proposed aircraft's specifications.

By the spring of 1968 development estimates had skyrocketed as Sud undertook more detailed design studies. In late June the British Ministry of Technology stunned the airlines by revealing that airframe development was now expected to cost \$516 million, an increase of 40 percent above the figures quoted in the 1967 MoU. Sud attributed this cost growth principally to modifications in design demanded by the potential customer airlines.³⁰

Harold Wilson's Labour government had good reason to be disturbed by the cost growth in the A-300 program and the airlines' lack of interest in the Airbus. Britain's economic situation had deteriorated considerably in 1967. The rapidly

²⁷Gianni (1971), pp. 405-406, 408-409.

²⁸Gianni (1971), p. 408.

²⁹Ibid., p. 404; *Aviation Week and Space Technology*, February 12, 1968, p. 30.

³⁰Hayward (1976), p. 362; *Aviation Week and Space Technology*, July 22, 1968, p. 21.

escalating cost estimates for the A-300 made the program difficult to justify in an atmosphere of economic crisis.³¹

At the same time, Rolls-Royce began experiencing serious doubts about the A-300 venture. The company had overcommitted itself, poorly managed its finances, and undertaken too much technological risk in its various engine development programs. In addition, estimated development costs for the RB.207 rose 12 percent to \$168 million in the first nine months following the Airbus MoU. As summer approached it became increasingly likely that one of its engine development programs would have to be scrapped. Considering the state of the Airbus program, that choice seemed self-evident.³²

Other Anglo-French collaborative projects were not going well either, contributing to increased tensions between the two nations. In June 1967 the French had withdrawn unilaterally from the joint variable-geometry fighter program (AFVG) launched at the same time as the Jaguar and Airbus design study. The Concorde project also continued to experience severe cost growth and schedule problems.³³

Other issues contributed to Anglo-French friction. Diplomatic relations between the two countries reached a low point at the end of 1967 with de Gaulle's "velvet veto" of Britain's second application for EEC membership. This ended Wilson's year-long campaign to bring the United Kingdom into the Common Market. De Gaulle's veto was bound to affect the Airbus program because Wilson's original desire to collaborate with the French had been partly motivated by his wish to bring Britain into the EEC.³⁴

Uncertainties and tensions mounted as the scheduled date for the final go-no-go decision approached. On August 2, 1968, two days after the government funding of the project officially ended, the technology ministers convened in Paris. They decided to grant the Airbus a 100-day reprieve, but the British stressed that during this three-month period the Airbus had to clearly demonstrate commercial viability to ensure their further participation. The negotiators agreed that three requirements should be met. First, estimated development costs had to be significantly decreased. Second, lower direct operating costs had to be guaranteed. Finally, all three national carriers had to commit themselves officially to 25 startup orders each.³⁵

Only a few months after this meeting, Rolls-Royce and BAC provided the decisive push in the British government's slide toward disengagement. Sometime in the fall of 1968 Rolls decided to halt development work on the RB.207. The design definition delays, cost escalation, and lack of interest in the Airbus shown even by the flag carriers seemed to portend commercial disaster for the A-300. Once Rolls perceived the Airbus program as being of no great commercial interest the company set out to convince the government that it was no longer of importance to Great Britain.³⁶

³¹*Aviation Week and Space Technology*, June 17, 1968, p. 21; Costello and Hughes (1976), p. 140.

³²*Economist*, June 29, 1968, p. 69; Hayward (1976), p. 362.

³³Costello and Hughes (1976), pp. 136-139; *Aviation Week and Space Technology*, June 17, 1968, p. 29; November 18, 1968, p. 35.

³⁴Costello and Hughes (1976), p. 136; Morgan (1973), pp. 209-210.

³⁵*American Aviation*, August 19, 1968, p. 31; *Aviation Week and Space Technology*, August 12, 1968, p. 46; December 23, 1968, p. 32.

³⁶Hayward (1976), pp. 361-362; Gianni (1971), p. 409; *Aviation Week and Space Technology*, July 22, 1968, p. 21.

Desperately trying to reverse the drift of events, engineers attempted to redesign an Airbus more acceptable to BEA and other European air carriers. With two potential competitors, the DC-10 and L-1011, already under development, the two continental partners did not want a third from Britain. On December 12, 1968, Henri Ziegler, President of Sud, publicly revealed a scaled-down 250 seat version of the Airbus christened the A-300B. Estimated development costs had been lowered nearly 20 percent to \$406 million. To further tempt the British, Sud chose another Rolls-Royce powerplant as the aircraft's standard engine; but to broaden the A-300B's appeal to airlines that used American transports, designers also offered the JT9D-3 and General Electric CF6 as optional powerplants. Because all three engines were already being developed for other civil transports, engine development costs for the A-300B would be minimal (see Table 9).³⁷

The British government reacted coldly. Rolls-Royce had its hands full with an engine contract for the L-1011. BEA preferred a newly proposed BAC design, the 311. Shortly after Ziegler's press conference, British government spokesmen announced that the terms of the Airbus MoU had lapsed. All British government funding ceased.³⁸ Government officials argued that the scaled-down Airbus still was not commercially feasible. British negotiators noted that extensive world-wide sales campaigns for the new A-300B design conducted by the participating firms had failed to secure a single firm order for the aircraft. The British feared involvement in another expensive collaborative commercial aircraft venture similar to the Concorde project. Finally, on April 10, 1969, a U.K. spokesman formally announced his government's intention to discontinue all participation in the European Airbus program.³⁹

This decision engendered considerable ill-feeling; nonetheless the French and Germans prepared to go it alone. Some years later the Director of Airbus Industrie gave a speech that expressed an attitude similar to that held by the French at this time. Noting that the A-300B was Europe's only entry in the wide-body commercial transport market, he proclaimed:

We are fighting for our children. If we don't have a place in high technology in Europe we should be slaves to the Americans and our children will be slaves. We have to sell, . . . we must fight, fight and fight. . . . (The A300B) is the bread and butter of the European aerospace worker.⁴⁰

Early in 1969 France and Germany made arrangements to relaunch the venture bilaterally, but they never ceased in their efforts to bring the United Kingdom back into the program. Britain eventually did rejoin, but only after the passage of more than ten years. In the meantime, the French and Germans reorganized the Airbus project and developed the first generation of aircraft with the help of Hawker-Siddeley, Holland, and Spain. The two governments formalized their agreement with the signing of a new MoU on May 29, 1969.

³⁷*American Aviation*, December 23, 1968, p. 16; *Aviation Week and Space Technology*, December 16, 1968, p. 29; Gianni (1971), p. 409.

³⁸*Aviation Week and Space Technology*, December 23, 1968, p. 32.

³⁹Hayward (1976), p. 362; *Aviation Week and Space Technology*, April 21, 1969, p. 30; December 23, 1968, p. 32; Reed (1973), p. 121.

⁴⁰*Flight International*, February 27, 1975, p. 317.

Table 9

EVOLUTION OF THE EUROPEAN AIRBUS DESIGN 1966-1968

Characteristic	Galion	HBN-100	A-300 (mid-1968)	A-300B (Dec. 1968)
Length overall (ft)	146.8	151.1	164	165
Wing span (ft)	136.9	128.1	148	147
Fuselage diameter (ft)			21 (252 in.)	18.2 (218 in.)
Passenger capacity	241	250	300-350	252
Max operating speed (mph)			438	433
Range (n mi)			1100	1200
Takeoff run (ft)			6560	6700-6988
Engine	JT9D	JT9D	RB.207	RB.211 [JT-9D-3, GE CF6]
First flight			1972	Fall 1972
Certification				Mid-1973
In service			Spring 1973	Winter 1973-74
Estimated development costs				
Airframe			\$516 million	\$406 million
Engine			\$169 million	"drastically reduced"
Unit cost			\$12.5-\$13.5 (est. 1973 \$)	\$11.3 (est. 1973 \$)

SOURCE: *Aviation Week and Space Technology*, February 12, 1968, p. 33 and December 16, 1968, p. 29; *American Aviation*, December 23, 1968, p. 16; Gianni (1971), pp. 404, 406.

THE A-300B AIRBUS, 1969-1974

The Franco-German MoU of May 29, 1969

The 1969 Franco-German MoU differed radically from the tripartite accord signed 20 months earlier. The negotiators drafted the new agreement in such a way as to minimize the problems that had plagued the A-300 program: schedule slippage, cost growth, and withdrawal of a participating government. The new document represented a fundamental change in approach in that it stressed cost, commercial, and market factors above other considerations.

The French and German governments agreed not to intervene in the resolution of technical problems; these decisions would be left to the firms involved.⁴¹ Both to ensure the commercial viability of the aircraft and to keep development costs down, the two governments established a development philosophy of seeking commonality with existing and projected commercial transports and purchasing off-the-shelf components wherever appropriate. See Table 10. This approach contradicted the "buy-European" philosophy of the 1967 MoU. The new accord instructed industry to choose the engine and other components for the Airbus according to the following criteria.⁴²

⁴¹Kracht (1974), p. 163.

⁴²Accord Entre le Gouvernement de la République Française et le Gouvernement de la République

- The likelihood of development delays.
- Technical merits—performance, endurance, maintenance, and price.
- Airline preferences.
- Interests of aerospace manufacturers of the participating nations.

Industry would make these decisions subject to governmental approval. As a result of these directives, the A-300B utilizes a wide range of off-the-shelf components in common with other commercial transports. U.S. components and spares account for 20 to 45 percent of the aircraft's unit price plus spares depending on equipment options.⁴³

In addition, designers consciously attempted to use standard technology. The only exception was the bonding technology in the fuselage and an extensive use of glass fiber in the wing leading edge and on the vertical stabilizer.⁴⁴

Table 10

A-300B EQUIPMENT COMMONALITY

Equipment	Company	Aircraft
Engine pods	McDonnell-Douglas	DC-10
Propulsion system	General Electric CF6	DC-10
APU	Garett TSCP 700	DC-10
Electrical generation	Westinghouse 90kVA generator with Sundstrand CSD	DC-10
Hydraulic pumps	Vickers-Sperry-Rand	B-747 L-1011 DC-10
Air conditioning	Garett	DC-10
Anti-icing	Garett	DC-10
Air bleed	Garett	DC-10
Air data system	Sperry	L-1011

SOURCE: Kracht (1974), p. 166.

Additional Partners and Withdrawal. The MoU encouraged Britain and any other interested country to join the new venture with the same privileges and obligations as France and Germany. The new MoU, however, contained a strict withdrawal penalty clause. Both Sud and Deutsche Airbus were bound to carry the development of the aircraft through type certification by both governments. In case of default on the industrial level, the underwriting government would remain financially responsible up to the originally agreed limit of funding.⁴⁵

Government Oversight. The MoU organized a fairly simple joint governmental oversight structure. (See Fig. 3.) An Intergovernmental Committee retained

Fédérale d'Allemagne Relatif à la Réalisation de l'Airbus A-300-B, 29 Mai 1969, Article 6, 10, and 11, quoted in Gianni (1971), pp. 430, 432 (hereafter cited as *Accord*).

⁴³Aviation Week and Space Technology, May 31, 1971, pp. 78, 81, 95; June 9, 1969, p. 33.

⁴⁴Aviation Week and Space Technology, October 19, 1970, p. 30.

⁴⁵Accord, Article 6, p. 431.

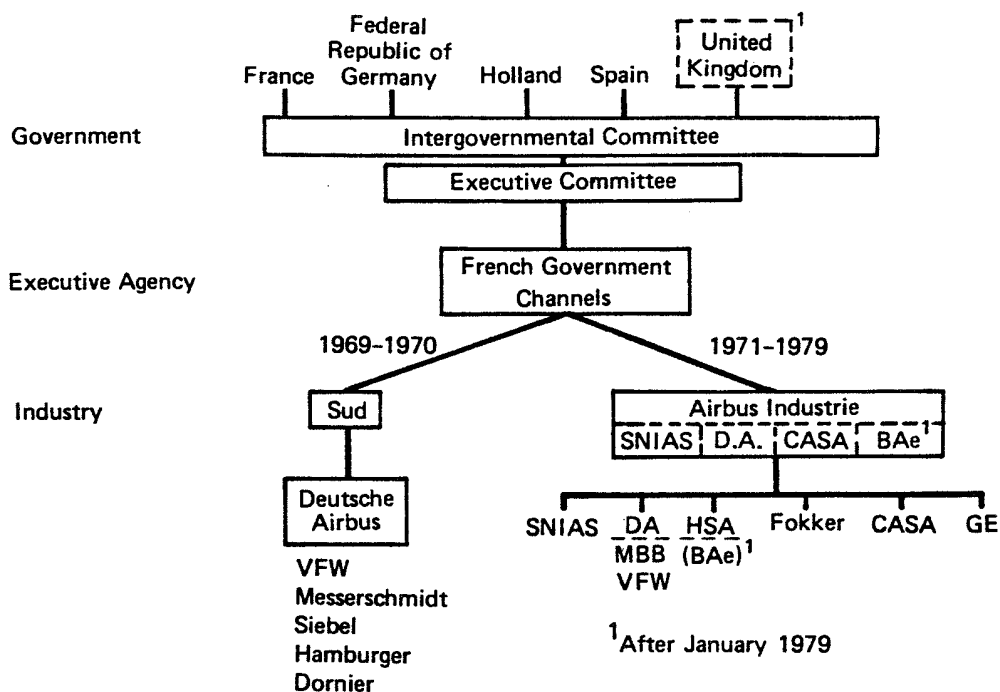


Fig. 3—Airbus (A-300B): Transparent or shadow firm

overall responsibility for all aspects of the program. As envisioned in the MoU, however, the committee would mainly concern itself with checking and approving decisions taken on the industrial level and with arbitrating disputes. An Executive Committee composed of one government representative from each country would carry out the decisions of the Intergovernmental Committee. The MoU created no new administrative structure for government oversight. Rather the two committees would use existing administrative services and channels of the French government under the title of the Executive Agency.⁴⁶

Industrial Organization, Work Sharing, and Finances. The MoU named Sud Aviation prime contractor and Deutsche Airbus associate contractor. The two were to transfer authority to a new joint organization as soon as possible. The Executive Agency would place contracts with Sud, which in turn would contract to Deutsche Airbus. All work on the airframe was to be divided according to the financial contribution of each government. This provision was soon violated.⁴⁷

The two governments each agreed to contribute one half of development costs up to a total ceiling of approximately 400 million 1968 dollars. Each government would pay its contribution in its own currency directly to its own industry.⁴⁸

Development Schedule. The 1969 MoU retained the original program set out two years earlier envisioning the construction of four flying test aircraft and two airframes for static testing. The document established a program length of 38

⁴⁶ Accord, Article 1, p. 429.

⁴⁷ Accord, Article 2-5, pp. 429-430.

⁴⁸ Accord, Article 7, pp. 432-433.

months to first flight (September 1972) and 50 months to FAA certification (August 1973).

The French and German governments wrote an agreement designed to minimize collaborative government bureaucracy and interference, maximize sensitivity to commercial forces, and discourage withdrawal from the venture. Tremendous concern remained, however, over whether the aircraft would be a commercial success. When the MoU was signed, the only orders that seemed fairly certain were from Air France and Air Inter, the French domestic airline, for a total of 25 aircraft.⁴⁹ Several airlines already had placed firm orders for the DC-10 and L-1011. The two governments increased pressure on Lufthansa and renewed their efforts to bring more European nations into the Airbus program in hopes of widening its potential market.

The Quest for Additional Partners

At the 1969 Paris Air Show Hawker-Siddeley signed a private commercial contract with Sud to continue its former role as designer and producer of the Airbus wings. The British firm agreed to raise \$30-35 million privately to contribute to the development effort. Eventually the Germans provided the bulk of Hawker-Siddeley's development funding, however.

After signing the contract with Hawker-Siddeley, the French and Germans mounted another major effort to bring the British government back into the project. To the two continental governments the stakes seemed very high. The central factor was not so much spreading development costs as expanding the potential market to British carriers and preventing the funding of a competitive British airbus.⁵⁰

Negotiations dragged on for more than a year and once again proved fruitless; on December 2, 1970 Britain formally refused to rejoin the European Airbus venture. Nonetheless, the French and Germans won an important victory because the British government also declined to finance the BAC-311 airbus.⁵¹

Some observers predicted that Britain's final refusal to join doomed the European Airbus program. But with the BAC-311 threat removed, France and Germany forged ahead, turning their efforts to an agreement with Holland. Dutch interest in the Airbus had grown after Fokker and VFW, a member of Deutsche Airbus, merged on May 8, 1969. In October the Dutch government offered to contribute financially to the Airbus project in return for the allocation of development and production work to Fokker-VFW. On December 28, 1970, a little over three weeks after Britain's formal refusal to rejoin, France, Germany, and Holland signed a new MoU bringing the Dutch into the venture. The Dutch government consented to contribute 6.6 percent of the development costs. The MoU transferred design and production work for the wing slats and flaps from Hawker-Siddeley to Fokker-VFW.⁵²

⁴⁹*Aviation Week and Space Technology*, June 9, 1969, p. 165.

⁵⁰*Aviation Week and Space Technology*, September 7, 1970, p. 48; *Economist*, December 5, 1970, p. 69.

⁵¹*New York Times*, December 3, 1970, p. 93; *Economist*, December 5, 1970, p. 69; *Aviation Week and Space Technology*, December 7, 1970, p. 16.

⁵²*Aviation Week and Space Technology*, November 3, 1969, p. 34; October 19, 1970, p. 31; Gianni (1971), p. 414.

The new arrangements were unique in that actual worksharing percentages were not based precisely on the percentage of financial contribution or on unit buys. This unusual situation arose because Hawker-Siddeley did not receive any U.K. governmental funding. Consequently, the British firm received about 17 percent of the total government development funding allocation although it contributed less than 7 percent of the total from its own private sources.

Table 11 presents an accounting of the origin and allocation of development funds.⁵³ Approximately 22 percent of the German contribution and 38 percent of the Dutch contribution went to financing Hawker-Siddeley's efforts and flight testing in France. German funds also financed the acquisition of engines, nacelles, and other equipment purchased in third countries for the construction of the flight test aircraft. German industry particularly objected to this arrangement because it privately had to raise 10 percent of the total German contribution.

Table 11

CONTRIBUTION AND ALLOCATION OF TOTAL
DEVELOPMENT FUNDS
(In percent)

Country	Contribution	Allocation
France	43.4	44.6
Germany	43.4	34
Holland	6.6	4.1
Hawker-Siddeley	6.6	17.3

SOURCE: Derived from Gianni (1971), pp. 419-420.
Excludes costs of second through fourth flying test aircraft.

The project underwent one final funding and work sharing readjustment during the development phase. Airbus officials sought Spanish participation in hopes of securing orders from Iberia Airlines.⁵⁴ Late in 1971 the Airbus partners successfully negotiated an agreement to bring in the Spanish government and CASA (Construcciones Aeronauticas S.A.). The new accord transferred work on the tailplanes, passenger door, and landing gear doors from German firms to CASA.⁵⁵ A new funding and work sharing arrangement was established as indicated in Table 12.⁵⁶ However, it is unlikely that these statistics reflect the actual funding and work sharing situation because no private contribution from Hawker-Siddeley is indicated. Nonetheless, the figures show that except in the case of Spain, financial contribution was not precisely equated with work allocation. Negotiators distributed development work as shown in Table 13.

⁵³Derived from Gianni (1971), pp. 419-420. Excludes costs of second through fourth flying test aircraft.

⁵⁴*Le Monde*, 25 April 1979, p. 45.

⁵⁵*Aviation Week and Space Technology*, December 7, 1972, pp. 32, 34; *Flight International*, December 2, 1971, p. 886; April 6, 1972, p. xx.

⁵⁶*Flug Revue + Flugwelt*, May 1976, p. 87; Kracht (1974), p. 164.

Table 12

AIRBUS FINANCIAL CONTRIBUTION AND
WORK ALLOCATION

(In percent)

Country	Financial Contribution	Work Allocation	
Germany	44.6	Deutsche Airbus	36
France	44.6	Aérospatiale ^a	36
Holland	6.6	Fokker-VFW	6.8
Spain	4.2	CASA	4.2
		Hawker-Siddeley	17

^aIn 1970 Sud merged with Nord Aviation and other firms to form the Société Nationale Industrielle Aérospatiale (SNIAS).

Table 13

WORK DISTRIBUTION

Company	Parts
Aérospatiale	Forward fuselage, bottom central fuselage with wing carrying structure, landing gear, final assembly.
Deutsche Airbus	{ VFW-Fokker: Two forward fuselage sections MBBA: Rear fuselage and tail unit.
Hawker-Siddeley	
Fokker-VFW	Main wing
	Flaps, lift dumpers, spoilers, air brakes, leading edge slats, and flap track fairings.
CASA	Tailplane, passenger doors, landing gear doors.

^aIn October 1968 Bölkow and Messerschmitt merged. Hamburger Flugzeugbau joined them in May 1969 forming Messerschmitt-Bölkow-Blohm.

After Britain effectively withdrew late in 1968, SNECMA reasserted its preference for the licensed production of the Pratt and Whitney JT9D engine for the Airbus. Because of a long association with United Aircraft, SNECMA had already invested heavily in tooling designed to manufacture the forgings and machined pieces in Pratt and Whitney engines.⁵⁷ Airbus management rejected SNECMA's preference, however, because of the high priority in the program now placed on commercial viability and possibly because of negotiations with GE over codevelopment of the CFM-56 engine. The General Electric CF6, already designated for the DC-10, was chosen over the JT9D to power the A-300B. The CF6 is constructed with a large number of castings instead of forged parts. Rather than

⁵⁷Pratt and Whitney is a subsidiary of United Aircraft, now United Technologies.

undertake a large scale retooling program, SNECMA decided to manufacture only those parts it could handle with its current facilities. This amounted to only about 20 percent of the engine's value. Responsibility for final assembly and testing brought SNECMA's share to about 25 percent of the engine.⁵⁸ Germany's MTU (Motoren-und Turbinen Union) received only about 10 percent of the engine work. The firm was apparently pleased, however, with the quality of the work allocated to it, which represented a very high technology aspect of engine cooling. Parts worth around two-thirds of the engine's value would be manufactured in the United States.⁵⁹

The Formation of G.I.E. Airbus Industrie

The 1969 Franco-German MoU awarded design leadership to Sud but called for the establishment of an international consortium to manage all technical, financial, administrative, industrial, and marketing activities of the Airbus project. It took until December 18, 1970, or nearly 19 months, to set up the company. Part of the problem resulted from the entry of the two new partners into the project, but available evidence suggests that squabbling among the participating firms caused considerable delays. Throughout 1970, Deutsche Airbus officials complained that the French totally dominated the project and were resisting the establishment of Airbus Industrie on an equitable basis. The dispute centered on the control of marketing, the funding of the marketing and production phases, and the legal status of Airbus Industrie.

VFW-Fokker and MBB (formerly Hamburger and Messerschmitt), as private firms, objected to having to invest significant amounts of company funds into the series production and marketing of the aircraft, when Aerospatiale (formerly Sud) was government-owned and subsidized. Government officials eventually resolved this problem by offering loan guarantees to both national industries. The French firm also insisted that financial responsibility should extend to the total financial assets of the firms participating in Airbus Industrie. Deutsche Airbus bitterly opposed this because Aerospatiale could always fall back on public funds. The debate became quite heated. Late in 1970 the German firms asked their government to threaten the withholding of further funding unless a deadline was set for the formation of Airbus Industrie on a basis acceptable to them.⁶⁰

Yet the French ultimately prevailed. On December 18, 1970 Airbus Industrie was incorporated under French law as an Economic Interest Grouping (Groupe-ment d'Intérêt Économique). A G.I.E. is not endowed with its own capital. Dues levied on members pay for operating expenses. Thus the member firms were jointly and separately liable for all debts incurred by Airbus Industrie up to their total individual resources.⁶¹

Airbus Industrie's charter originally limited full membership to Aerospatiale and Deutsche Airbus. Each company theoretically exercised equal rights in all

⁵⁸ *Aviation Week and Space Technology*, May 31, 1971, p. 93.

⁵⁹ *Flight International*, May 31, 1971, p. 212.

⁶⁰ *Aviation Week and Space Technology*, December 14, 1970, p. 28; May 31, 1971, p. 97; Gianni (1971), p. 421.

⁶¹ *Statuts du Groupement d'Intérêt Économique Airbus Industrie, 18 December 1970*, in Gianni (1971). Article 4, p. 437 (hereafter cited as *Statuts*).

aspects of the organization. The consortium's statutes granted Hawker-Siddeley and Fokker-VFW consultant status. Airbus Industrie later admitted CASA as a member. Membership rights were then redivided as shown in Table 14.⁶²

At the beginning of 1979 the participating firms again divided membership rights, granting British Aerospace a 20 percent interest in the consortium. The admission of new members and the redivision of rights requires unanimous agreement. The statutes specifically forbid the unilateral withdrawal of any member for the duration of the commercial operation of the A-300B.⁶³

Table 14

AIRBUS INDUSTRIE MEMBERSHIP RIGHTS

Company	Percent
Aerospatiale	47.9
Deutsche Airbus	47.9
CASA	4.2

Organization. The following is a description of the organizational structure of Airbus Industrie during the completion of RDT&E. A Board of Directors headed Airbus Industrie. Five representatives each from Aerospatiale and Deutsche Airbus originally composed the Board. (Presumably now CASA and BAe also have representation.) Hawker-Siddely and Fokker-VFW each sent one observer.⁶⁴

A Managing Director was elected for a five year term by an Assembly of Members. The Director supervised a Management Committee made up of two French and two German managers in charge of technical issues, production, administration and finance, sales, and overall coordination. The Managing Director and the President of the Board had to be of different nationality.⁶⁵

In a sense the statutes established a dual authority for Airbus Industrie because the Managing Director possessed an important veto power over key decisions of the Board. In decisions involving changes in the aircraft, transfer of work, agreements with third parties, and so forth, the Board and the Managing Director had to agree. In reality this provision seems to have operated in the favor of the French because the Director possessed an absolute veto power on these issues and this position has always been held by a Frenchman. The President of the Board was German, but the French had equal representation there. The French could always veto a German initiative but the Germans couldn't stop a French one if their delegation was split in the Board.⁶⁶

French industrial interests have probably been well served in Airbus Industrie. The first Director elected was Henri Ziegler, president of Aerospatiale, former president of Breguet, and head of the Atlantic project. He was followed in 1975 by Bernard Lathière, a life-long French aerospace advocate both in industry and

⁶²Kracht (1974), p. 164.

⁶³*Statuts*, Article 5-12, pp. 437-438.

⁶⁴*Statuts*, Article 19-21, pp. 440-441.

⁶⁵Gianni (1971), p. 424.

⁶⁶*Statuts*, Article 18, p. 424.

government. He was assisted by a Frenchman, Roger Beteille. The current directors of flight testing, and finances and administrative coordination are also French. The German in charge of production actually had lived in France and worked for French aerospace firms for much of the period following World War II and acted as a French liaison official on the Transall program.

The A-300B Development Program

After the formation of Airbus Industrie late in 1970, the participating nations concentrated their efforts on the actual development and marketing of the aircraft. Remarkably, the development schedule remained largely unchanged from that originally established in the ill-fated 1967 MoU.

Since the fall of 1969, marketing teams had been very active in maintaining contacts with the world's airlines and keeping the industrial partners informed. By mid-1972, air carrier suggestions had led to the examination of at least ten possible versions of the basic A-300B.⁶⁷ By the end of the year management had settled on two of these versions, the stretched B2 and B4,⁶⁸ as the series production models. The most recent Atlas airline group specifications determined this choice.⁶⁹ Consequently only the first two test aircraft built for evaluation and certification purposes were B1 versions.

The choice of the B2 and the B4 as the basic versions for series production did not require major design changes. The development testing and evaluation program progressed uneventfully.⁷⁰ Construction of the first B1 began in September 1969. The aircraft made its maiden flight on schedule slightly over three years later on October 28, 1972. The first B2 flew on June 28, 1973. French and German authorities granted type certification in March 1974, followed two months later by FAA certification. The first B2 entered service with Air France on the Paris-London route in May 1974.⁷¹

SCHEDULE, COST, PERFORMANCE

The Airbus program experienced little or no schedule slippage from the 1967 MoU until the first flight of the first preproduction aircraft. There are indications of schedule slippage, however, with the first flight of the third preproduction Airbus. The A-300B finally entered service approximately 12 months later than the original 1967 prediction for a total schedule slippage of about 20 percent. The schedule slip occurred primarily in the summer of 1973 when the first B2 aircraft was undergoing testing and evaluation and the second was under construction. Also at this time engineers introduced Krueger flap modifications on the No. 1 aircraft. Thus the last minute decision to go into series production with the stretched B2 and B4 versions probably accounted for much of the delay.⁷²

⁶⁷*Interavia*, November 1972, p. 1212; *Jane's All the World's Aircraft* (1975-76), p. 106.

⁶⁸A-300B2, fuselage stretched 8.7 ft, 281 passenger capacity; A-300B4, increased range version of B2.

⁶⁹Air France, Lufthansa, Alitalia, Sabena, and Iberia. *Flight International*, April 6, 1972, p. xxi.

⁷⁰*Aviation Week and Space Technology*, February 7, 1972, p. 36; *Air Enthusiast*, August 1972, p. 71.

⁷¹*Jane's All the World Aircraft* (1975-76), p. 106.

⁷²*Aerospatiale*, April 1975, p. 14; *Air Enthusiast*, August 1972, p. 100.

By the end of 1978 the participating governments had expended nearly one billion 1978 dollars on the Airbus program and had guaranteed loans for another billion to finance series production. The A-300B R&D program appears to have experienced a real cost growth after inflation of about 12 percent.⁷³

Most indications suggest that the A-300B is a technical success. During flight testing and evaluation it met or exceeded most performance expectations. Two of the most important commercial performance goals, low operating costs and reliability, seem to have been achieved.⁷⁴

Airbus Industrie claims a despatch reliability to five minutes of around 98 percent.⁷⁵ Eastern Airlines calculated its A-300Bs operated with 30 percent better seat-mile economy than its B-727s and 20 percent better than its L-1011s.⁷⁶ (See Table 15.)

Table 15

TOTAL AIRCRAFT OPERATING EXPENSES PER SEAT
MILE, FIRST QUARTER, 1979
(Cents per seat mile)

A-300B ^a	L-1011 ^b	L-1011 ^c	DC-10 ^d	B-747 ^e
1.96	2.39	2.27	2.08	2.22

SOURCE: Derived from *Aviation Week and Space Technology*, July 2, 1979, pp. 48-49.

^aEastern.

^bEastern.

^cAverage of Eastern, TWA, and Delta.

^dAverage of United, American, Continental, Northwest, Western, and National.

^eAverage of PanAm, TWA, United, Northwest, American and Braniff.

In the areas of low cabin noise and passenger comfort the Airbus has also received high marks. Boeing vice-president and designer of the 727 Jack Steiner expressed the feelings of many of the Airbus's competitors: "I've seen the plane, and it appears to be an excellent product for its particular slot, the high density, European capital to capital market."⁷⁷

CONCLUSIONS

The A-300B development program was reasonably successful in terms of cost, schedule, and performance. However, the first phase of the Airbus program (1965-

⁷³Based on data from Limouzy (1976-1977), Vol. 1, p. 179, Vol. II, p. 65; *Aviation Week and Space Technology*, October 28, 1974, p. 36; *Le Monde*, "Deux Milliards de Francs d'Investissements," April 25, 1979, p. 45.

⁷⁴Kracht (1974), pp. 169-175; *Interavia*, July 1975, p. 791; also see Phillips (1971), Chaps. 5 and 6.

⁷⁵*Aérospatiale*, January 1975, p. 2; April 1975, p. 14.

⁷⁶*Flight International*, April 15, 1978, p. 1030.

⁷⁷*Forbes*, September 1, 1972, p. 34.

1968) more closely approximated the dismal record of the Transall and Concorde ventures. During this first phase, two equal partners, France and the United Kingdom, expended nearly four years bargaining over design, project leadership, choice of components, and market share. The ensuing compromises, derived from a series of national and political industrial tradeoffs, resulted in a commercially unsound proposed aircraft that no airline would order. The much more successful second phase (1969-1974) differed from the first in two key respects. First, the partners were not equal; France clearly dominated the project. Second, the partners shifted their priorities in order to make the R&D program more responsive to commercial and cost considerations. The following factors appear to be among the more important elements contributing to the relative success of the A-300B project:

1. With only some minor exceptions, the A-300B uses conventional technology. Few technological innovations were required in the development program, making it a very low risk venture.
2. U.S. components originally designed for other aircraft or bought off-the-shelf constitute up to 45 percent of the unit price plus spares for the A-300B. The single most important item in this category is the GE CF6 engine. For the preproduction aircraft the engines were purchased directly from General Electric. This procedure eliminated most of the risks and costs undertaken in an independent engine development program.
3. The Airbus participants established a single chain of command. In practice this meant French domination of the project. For nearly two years Sud (later Aerospatiale) managed the project as the pilot firm. Theoretically German industry achieved equality after the formation of Airbus Industrie, but most of the key management positions remained in the hands of French industry representatives. Airbus Industrie completed development of the A-300B under the guidance of a managing director who was also the president of Aerospatiale.
4. After the withdrawal of Britain in the winter of 1968-69, France and Germany departed radically from the pattern of previous codevelopment projects by agreeing to subordinate national industrial considerations to commercial, cost, and technical priorities. By 1969 it was clear that to win sales even from the participants' flag carriers the Airbus would have to compete to a large extent on its own merits against privately developed U.S. aircraft. To make the Airbus a commercial success managers developed a healthy sensitivity to the needs of potential user airlines. The air carriers were most concerned with price, economy, reliability, performance, and delivery dates. To sell the A-300B these criteria as set by the airlines had to be met.

Consequently, to an extent unprecedented in codevelopment programs before or since, the Airbus partners designed the aircraft and chose components according to potential user preferences, technical merit, cost, and the prospects for minimizing delays. Direct government intervention in industrial decisionmaking was kept to a minimum. The 1969 MoU instituted a development cost ceiling, work progress funding, and severe industrial withdrawal penalty clauses. The participants established only one final assembly line and flight test center to avoid unnecessary

duplication. The Airbus program was one of the few European codevelopment ventures where work was not allocated strictly according to government financial contribution or unit buy.

Particularly with respect to commercial viability, the A-300B project was unique. It is also generally considered to be one of the most successful aircraft codevelopment projects undertaken by the Europeans. Nonetheless, regarding the implications of this project for possible future transatlantic large aircraft codevelopment, several other factors must be kept in mind:

1. Like the Atlantic program, the A-300B venture might be justifiably described as essentially a French R&D project with substantial, although secondary, foreign participation (except in the financial area). The French probably would not have participated without project leadership.
2. Despite the high percentage of U.S. components and parts utilized on the A-300B, the French and Germans explicitly rejected the participation of U.S. firms in overall management and direction of this program. The Airbus, like the Concorde, was intended to help a French-led Europe undercut U.S. domination of the world commercial transport market.
3. The emphases on cost, performance, and user requirements that characterized the A-300B project are unlikely to be carried over to future military codevelopment programs. With their armed forces as a guaranteed market, the participants in future military codevelopment projects will probably return to the established pattern of negotiating for the maximization of national industrial and political objectives. This appears to be the case in the more recent Alpha Jet, Tornado, and the future European Tactical Combat Aircraft (TCA) programs.⁷⁸

⁷⁸See *Le Monde*, October 17, 1979; *International Defense Review*, August 1979, p. 1283.

V. CONCLUSIONS AND IMPLICATIONS

The preceding sections examined a small but diverse collection of European large aircraft codevelopment programs. From this examination four general propositions emerge:

- U.S. and European objectives for pursuing codevelopment fundamentally differ.
- Collaboration on past programs generally did not promote the rational and efficient management of national or multinational R&D resources.
- Codevelopment seems to have contributed to unsatisfactory or undesirable schedule, cost, and performance program outcomes from the U.S. perspective.
- The essential attributes of the programs that incurred the least severe schedule, cost, and performance penalties would be difficult to incorporate into a transatlantic program.

The remainder of this section elaborates on these propositions and comments on their implications for the transatlantic codevelopment of large aircraft.

DIFFERING U.S. AND EUROPEAN OBJECTIVES

The dilemma confronting policymakers attempting to encourage transatlantic codevelopment programs is that U.S. and European objectives differ fundamentally and occasionally conflict. U.S. objectives may be summarized as follows:

- Enhance NATO military capabilities by increasing NATO equipment rationalization, standardization, and interoperability.
- Promote the more efficient use of R&D funds and resources through consolidation and the rational division of tasks in order to reduce R&D redundancies.
- Strengthen transatlantic NATO links.

The major European states have collaborated with each other in the past for quite different reasons. These include three basic categories of objectives:

- Maintain diversified and broadly based national R&D aerospace capabilities with restricted national defense budgets.
 - Reduce R&D costs for each participant to below the level of a national program.
 - Maintain or expand national employment levels and skills.
 - Acquire new technologies.
 - Encourage program stability.
- Advance regional political objectives.
 - Contribute to the formation of a Franco-German block.
 - Facilitate British entry into the Common Market.

- Promote European solidarity.
- Counter U.S. aerospace competition.
 - Pool European industry for the development of aircraft to encourage European governments to buy European.
 - Combine European resources in development, production, and marketing to strengthen European sales worldwide.

It is primarily because of these differing objectives that, viewed from the narrow framework of alternative weapon systems acquisition strategies, European codevelopment programs often appear to have been unsuccessful from the U.S. standpoint. From the European perspective, however, codevelopment is seen in at least some quarters as having satisfactorily served the broader regional political, industrial, and commercial objectives it was intended to promote.

In addition, at least some of the European objectives indicate a degree of commercial, political, and technological rivalry with the United States that may hinder the prospects for transatlantic codevelopment. If nothing else, the European approach to codevelopment has led to substantially different results from those expected by the U.S. advocates of transatlantic R&D collaboration.

THE MANAGEMENT OF POOLED R&D RESOURCES

Advocates of transatlantic codevelopment argue that considerable cost savings and an augmentation of overall military capabilities would ensue from a consolidation of NATO R&D expenditures and a curtailment of R&D redundancies. This contention assumes at least a modicum of national industrial specialization and international industrial rationalization. Yet it is doubtful that past European large aircraft codevelopment programs have contributed significantly to these objectives. This assertion cannot be corroborated statistically but rather arises from the publicly acknowledged principles that dictated the structure and management of the programs.

Some transnational industrial rationalization occurred on large aircraft codevelopment programs where one participant clearly dominated and cost considerations held the highest priority, as on the A-300B Airbus program. In general, however, R&D and production work were rarely allocated according to the precepts of relative economic advantage or cost effectiveness. Rather officials distributed work in accordance with each participant's projected unit buy and financial contribution. All participants tried to minimize rather than enhance national industrial specialization. This cardinal objective necessitated the awkward and inefficient division among all participants of R&D work on every major component and subsystem. Thus the manner in which work was assigned did not decisively reduce R&D redundancies. This is not surprising because a central purpose of codevelopment for the Europeans is to permit governments with limited funds to support a full range of aerospace R&D activities on the national level.

Employment considerations and other national industrial objectives determined each government's preferred choice of contractors and components. The final selections for a collaborative program emerged only after arduous bargaining among national representatives. Negotiated industrial tradeoffs led to such ineffi-

cient and sometimes disastrous choices as the RB.207 for the A-300 Airbus and the establishment of three separate assembly lines for the Transall prototypes. Once negotiators reached an acceptable compromise the collaborating governments typically designated the same pilot firm and associate contractors to design, develop, and produce the aircraft. Neither industrial competition nor considerations of cost effectiveness and transnational industrial specialization played a determining role in the selection of contractors and components.

If collaboration on the development of large aircraft failed to diminish R&D redundancies and promote the rational management of transnational R&D resources, it also did not result in any meaningful increase in NATO equipment standardization and military capabilities. In every case participants withdrew from the large aircraft programs before the official program launch or later refused to procure the aircraft. In the case of the Atlantic, nine nations withdrew during the project definition phase, and of the remaining five participants only two initially agreed to procure the aircraft. Often NATO nations procured nationally developed aircraft that directly or indirectly competed with the comparable codeveloped aircraft. By the late 1970s France, Germany, Holland, and Italy had deployed the Atlantic, while Norway (and also later Holland) purchased the P-3 Orion and Britain procured the Nimrod. France, Germany, and Turkey fly the Transall, but Belgium, Denmark, Italy, Norway, Turkey, and Britain procured the Hercules. If anything, these European codevelopment projects may have contributed to less standardization and interoperability within NATO.

In addition, because of requirements compromises, and delays in deployment perceived as stemming from codevelopment, there appears to be considerable dissatisfaction among certain European military circles with the military effectiveness of many codeveloped aircraft. With the Transall it has been reported that Luftwaffe officials believed they had been compelled to accept an aircraft that did not suitably meet the Luftwaffe's own unique requirements, although it was standardized with that of their French ally. The Germans may also have been displeased with the Atlantic, and at least some elements within the Armée de l'Air are clearly dissatisfied with the Transall. Comments such as that made in 1973 by General Paul Stehlin, former French air force chief of staff, labeling the Anglo-French collaborative Jaguar "our most costly and ill-conceived aircraft," are not at all atypical of other codeveloped aircraft.¹

It is far from certain, then, that European codevelopment programs have in any meaningful sense increased NATO military capabilities, lessened R&D redundancies, or encouraged industrial rationalization.

SCHEDULE, COST, AND PERFORMANCE IMPLICATIONS

Given the observation that European large aircraft codevelopment programs generally served national industrial and political interests at the expense of the rational and cost-effective management of pooled R&D resources, they should also expect to incur schedule, cost, and performance penalties. Such penalties, if indeed they are inherent in the process of codevelopment, may be viewed by U.S. policy-

¹Quoted in Carlier (1979), p. 148.

makers as too high a price to pay for any benefits that may accrue from codevelopment.

It is difficult to determine with any degree of statistical precision to what extent collaboration affected European program outcomes. European governments have been traditionally reticent about divulging the data necessary to make such determinations. Even if the data were accessible, relevant comparisons among U.S. national, European national, and European collaborative R&D programs would be complicated by the divergence in R&D philosophies, procedures, definitions, requirements, accounting methods, and a myriad of other factors, even when they are programs for comparable types of aircraft. Yet, although hard data are not obtainable, and often seem to be unavailable even to the participants themselves, most informed observers and many of the participants openly acknowledge that the inefficiencies and compromises inherent in collaboration often lead to substantial total schedule, cost, and performance penalties compared with national programs. Certain comparisons among various collaborative and national programs, although admittedly somewhat crude and imprecise because more specific data are lacking, nonetheless sustain this contention.

Schedule

The Atlantic, Transall, and Airbus R&D programs all took considerably longer than U.S. programs for similar aircraft.² (See Table 16.) The European and U.S. projects are not exactly comparable. For example, the Europeans developed the Atlantic from the beginning, whereas the United States developed the P-3 Orion

Table 16

SCHEDULE COMPARISONS FROM OFFICIAL
PROGRAM LAUNCH
(Ratio European to American)

Aircraft	To First Flight	To IOC ^a or Equivalent
Atlantic/P-3 Orion	1.6/1	1.6/1
Transall/C-130 Hercules	1/1	1.5/1
Airbus/2 U.S. widebodies (DC-10, L-1011)	1.4/1	1.4/1
Three European transports (BAC 111, HS 121, Caravelle)	1.4/1	1.9/1
Two U.S. transports (B-727, DC-9)		
U.K. Military transport (Short Belfast)	1.6/1	1.3/1
C-130 Hercules		

^aInitial operational capability.

²Longer program length is not necessarily always a negative or undesirable outcome.

from a flying prototype of the Lockheed Electra commercial airliner. Nearly all the U.S. aircraft are heavier and larger than their European counterparts. Yet it is not entirely unreasonable to assume that most of the anomalies on either side of the comparisons cancel each other out. Although the precise ratios in Table 16 may be open to dispute, none of them are at or below unity with respect to total R&D program length.

All four of the large aircraft European codevelopment projects also suffered schedule slippage. Although the severity of the slippage varied among them, in the cases of the Concorde and Transall it was considerable as shown in Table 17.

Table 17

PERCENT SCHEDULE SLIPPAGE FROM
OFFICIAL PROGRAM LAUNCH

Aircraft	To First Flight	To IOC or Equivalent
Atlantic	0	17
Airbus	0	20
Concorde	74	62
Transall	27	108

One cannot claim with certainty that longer program schedules and schedule slippage were caused by the collaborative process, because traditionally European national programs have taken longer than similar U.S. programs (Table 16). Yet there is at least some direct evidence that from experience Europeans fully recognize and expect the "friction" of collaboration to entail schedule penalties. As an example, the A-300B Airbus program was reportedly scheduled to take eight months or 20 percent longer than the DC-10 because of "the complexity of the problems of cooperation."³ At least one relevant point about schedule can be made with confidence—both European codevelopment and national R&D programs tend to take longer than comparable U.S. programs; all other things equal, most Europeans believe collaboration on R&D adds to program length and makes schedule slippage more likely.

Cost

All of the collaborative large aircraft development programs showed real cost growth when initial R&D program estimates are compared with final estimates and corrected for inflation (Table 18). Again, there is a wide range, from a reasonably moderate 12 percent cost growth for the A-300B Airbus to a distressing 383 percent for the Concorde.

Despite the difficulties in obtaining reliable and comparable data, the unit prices of the European aircraft appear to exceed those of their U.S. counterparts.

³According to Gianni (1971), p. 418.

Table 18

R&D PROGRAM COST GROWTH

Program	Percent Cost Growth	Program	Percent Cost Growth
A-300B Airbus (1969-74)	12	Atlantic	65 ^a
A-300 Airbus (1965-68)	58	Transall	120
		Concorde	383

^aIncludes initial production aircraft.

Lower U.S. prices, of course, may reflect nothing more than the far longer production runs enjoyed by U.S. aircraft. At least one authority has drawn correlations between higher development costs and higher unit prices for European aircraft.⁴ In addition, both British and French parliamentary reports have concluded that increased R&D costs due to codevelopment directly contribute to higher unit prices.⁵

Other striking indications of the unwelcome effects of codevelopment on cost and price abound. With respect to cost, the Europeans have generally established the goal of decreasing the total *national* cost of R&D incurred by each partner compared with that of a national program. This goal can be achieved as long as the total cost of a bilateral program remains less than *twice* the cost of a national program. Yet many observers dispute whether even this modest goal is often attained. For example, in the early 1970s the French Cour de comptes⁶ prepared several legislative reports harshly criticizing the government for massive cost overruns incurred on codevelopment programs.⁷ Both the Concorde and the Transall have lengthy histories of intense public criticism for being extremely costly political programs. Other aircraft codevelopment programs have also come under attack for costing each participant individually more than a national program.⁸

Performance

With the available evidence it is extremely difficult to measure performance shortfalls accurately or make meaningful comparisons among European and U.S. aircraft, in part because of the differences in original requirements. For example, selected statistics suggest that the C-130 provides superior performance at a lower unit price than the Transall. The French and Germans would argue, however, that their military requirements stressed STOL capabilities, hot weather performance,

⁴Hochmuth (1974), pp. 150-152.

⁵House of Commons, *Second Report from the Select Committee on Science and Technology, Session 1968-69* (London, 1969), p. xlvii; Cour de comptes, "La Cooperation Internationale dans la Construction Aéronautique," *Journal Official Documents Administratives*, Paris, 3 July 1973, pp. 733-734.

⁶The Cour de comptes is a quasi-legislative equivalent to the U.S. General Accounting Office.

⁷Cour de comptes, "Rapport de la cour de comptes au Président de la République sur l'année 1970," *Journal Official Documents Administratives*, Paris, 1972; Cour de comptes, "La Cooperation Internationale dans la Construction Aéronautique," *Journal Official Documents Administratives*, Paris, 1973.

⁸For example, see Walker (1974) on the MRCA Tornado.

and fuel economy, areas where they would claim the Transall outperforms the Hercules.⁹ The Atlantic exceeds the performance of the Lockheed P-3 Orion in maximum range and service ceiling, but not in maximum speed. In addition, it initially suffered major airframe fatigue problems associated with unexpected difficulties from rust. By all accounts, however, the Airbus appears to perform comparably to or better than other aircraft in its class. All the U.S. aircraft have unquestionably done far better in the area of foreign sales, but this may reflect unit price, after-sales support, diplomatic and other considerations besides performance differentials. Whether the European aircraft R&D programs once underway experienced performance shortfalls and, if so, to what extent they were due to the effects of collaboration is nearly impossible to ascertain from the literature.

Despite these qualifications, codevelopment programs clearly resulted in performance shortfalls or undesired excess capabilities at increased cost in that they normally required the participants to compromise on their nationally determined requirements. This was particularly true in the cases of the Transall and the A-300 Airbus. The Transall design evolved from a less than satisfactory compromise between a German requirement for a short-range tactical STOL transport and a French requirement for a long range heavy transport.¹⁰ Despite their well-founded objections to the British RB.207 turbofan, the French grudgingly agreed to accept this engine for the A-300 Airbus. Subsequently this concession jeopardized the entire development program and rendered the proposed aircraft less attractive to potential users. In nearly all codevelopment programs participants had to modify their national requirements at the expense of the national military or commercial user. In this sense codevelopment inevitably led either to performance shortfalls or to costly unwanted excess capabilities.

With respect to schedule, cost, and performance, the available evidence does not permit a precise statistical accounting of the effects of collaboration on program outcomes. Nonetheless, it does strongly suggest that codevelopment programs took longer and cost more to produce aircraft that rarely met the original national requirements of the participants.

BARRIERS TO SUCCESSFUL TRANSATLANTIC CODEVELOPMENT

Perhaps the most intriguing and valid aspect of the above comparisons relates to the wide variation in program outcomes discernible among the European collaborative programs themselves. Assuming that less schedule slippage and cost growth are more desirable, the Atlantic and A-300B Airbus projects generally were more successful than the Transall, Concorde, and A-300 Airbus programs (see Tables 17 and 18). This perception has been repeatedly confirmed by the projects' participants themselves. Figure 4 pinpoints the four elements most commonly referred to by the participants and other authoritative observers as the key ele-

⁹For example, see *Aérospatiale*, March 1977, pp. 7, 11; October 1977, pp. 3-6; *Revue Mensuelle de l'Armée de L'Air*, 280, 1971, pp. 523-530.

¹⁰The recent French need to secure the assistance of C-141s and C-5s of the U.S. Military Airlift Command to facilitate their 1978 intervention into Kolwezi may be one example of the consequences of the French decision to compromise on the range/load characteristics of the Transall.

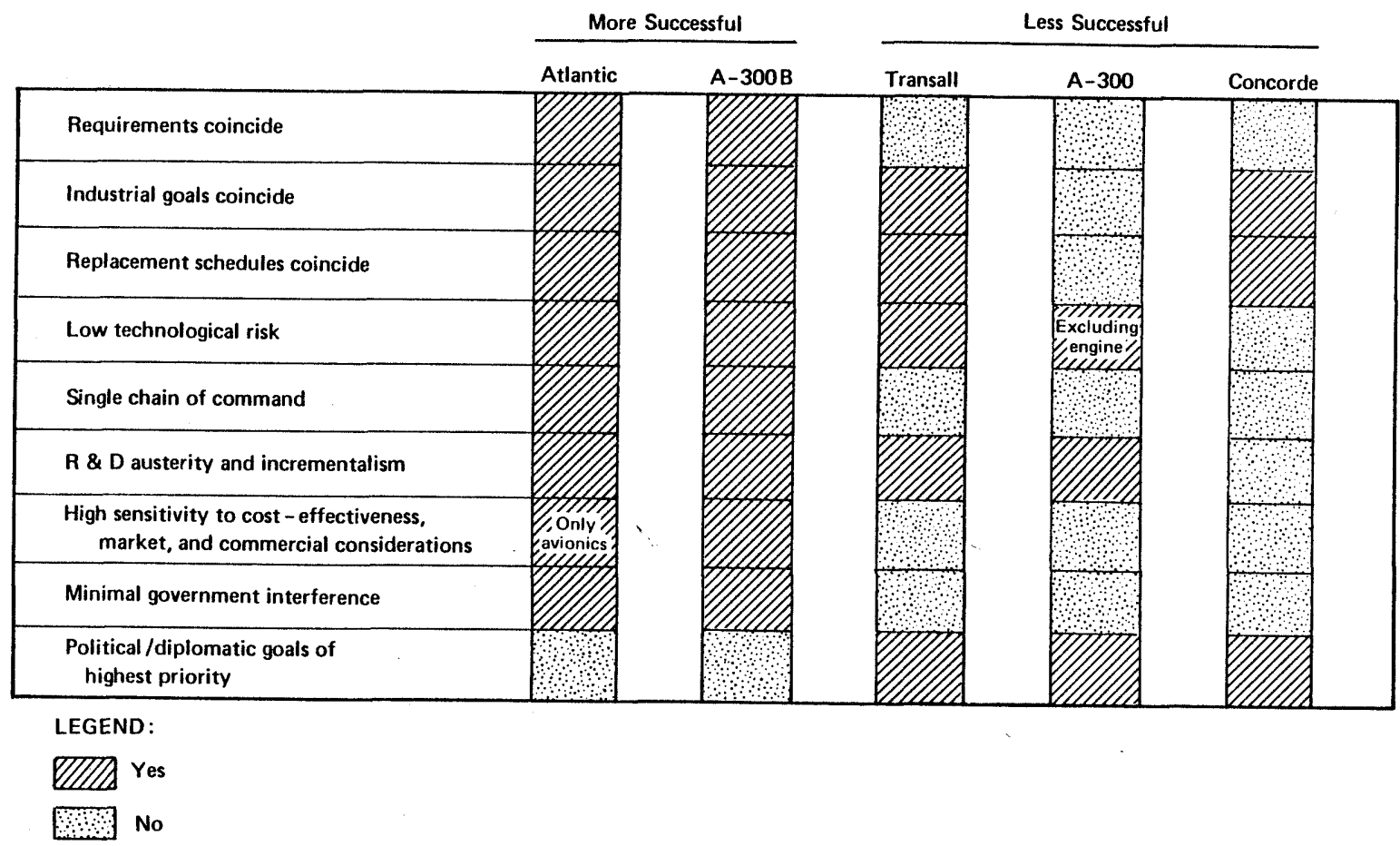


Fig. 4—Codevelopment program attributes

ments distinguishing the more successful from the less successful projects. These include:

- Similar national requirements
- A single chain of command
- High sensitivity to cost-effectiveness factors
- Minimal high-level government interference.

Other factors such as development strategy and technological risk seem to correlate less closely with the relative success of the programs.

Past experience suggests that it would be extremely difficult to incorporate these elements in a transatlantic large military aircraft codevelopment program. It is always possible that the United States and its potential European partners would begin a project with similar requirements, but this has been rare in the past even between adjacent European states. More often a compromise resulted that satisfied no one. A single chain of command also would be difficult. In the past this has typically meant French domination. In the future neither the major European states nor the United States would probably accept a genuinely subordinate role. The most successful European programs took place between France and Germany when the latter was forced by political and industrial circumstances to accept a subordinate role.¹¹ Projects between more equal partners, such as France and Britain, experienced many more difficulties.

The intractability and persistence of these obstacles is readily apparent in the ongoing European negotiations for a codeveloped tactical fighter for the 1980s. It took well over two years of intensive government discussions before British, German, and French industry negotiators were finally able to formulate a tentative joint definition in March 1980. As in past codevelopment programs, the difficulties stem from the problem of reconciling widely differing requirements and from the conflicting demands of all three national industries for project leadership.¹² Since the 1960s these problems have become increasingly difficult to resolve in Europe as France has become less willing and able to assume a dominant role and Germany has overcome earlier political and industrial barriers to equal partnership.

Clearly the makeup of past and current codevelopment programs in Europe mirrors the political and economic relationships of the states involved. Collaborative programs have always been the province of the highest levels of government because they have always been harnessed to and reflected important political objectives.

The A-300B Airbus, because it had to be a commercial success, remains the only project where cost-effectiveness considerations and user preferences overruled national industrial and political objectives to any significant extent, and where government and political interference remained at a comparative minimum. The Atlantic program enjoyed minimal government intervention primarily because it was totally dominated by French industry. There are few indications that future military codevelopment projects will diverge from the well-established pattern of

¹¹This generality does not apply to the Transall project after the formulation of joint requirements because Germany was able to increase its leverage by threatening to produce the C-130 under license and because of other political and economic circumstances (see Section III).

¹²*Le Monde*, October 17, 1979. *Aviation Week and Space Technology*, April 7, 1980, p. 14.

past and current programs by adopting the unique commercial priorities imposed on the A-300B project. Consequently, it seems improbable that those elements most likely to minimize undesirable cost, schedule, and performance outcomes could be incorporated in a transatlantic large military aircraft codevelopment project, if the established European patterns remain intact; and if this observation proves correct, participation in transatlantic programs would probably be deemed unwarranted by the United States given governmental objectives. Even if the likelihood of undesirable program outcomes could somehow be minimized, it remains to be seen whether the major European states would welcome U.S. participation on programs that historically have been closely associated with European regional political objectives often at cross purposes with U.S. policies.

At times regional political considerations appear to have heavily influenced the origin and the evolution of most European codevelopment programs. Nearly all aircraft codevelopment program starts occurred during the presidency of Charles de Gaulle. All of the large aircraft programs were initiated by the French, used French designs, or were dominated by the French. To a large extent the programs served as a tool of Gaullist foreign policy. This was particularly true of the Franco-German programs. Regional political and diplomatic imperatives also influenced German and British participation. The Concorde and Airbus programs were closely linked to Britain's quest for Common Market membership. Germany sought collaboration on the Atlantic, Transall, and Airbus programs in part to strengthen its political bonds with France. These political objectives were regional and polycentric and by their very nature demanded the exclusion of the United States.

Another fundamental European goal ruled out U.S. participation: countering U.S. aerospace competition in Europe and worldwide. All the programs had a primary objective of bringing together the participants' resources and markets in an attempt to offer Europeans a European alternative to existing or planned U.S. aircraft. In most cases the participants excluded official U.S. government participation, except for funding, as a matter of basic policy. In view of this past experience, the questions of transatlantic commercial, industrial, and technological rivalry must be addressed before codevelopment can be seriously contemplated in the sphere of large aircraft. These are particularly urgent questions considering the persistent European fear of industrial domination by the United States and the continued advocacy of European aerospace collaboration as an important means of avoiding permanent subordination to the United States in areas of high technology.¹³

Transatlantic large military aircraft codevelopment may be possible and even politically desirable in the future depending on the inducements offered and the concessions granted on both sides of the Atlantic. This would assume a major shift in the complex array of political, diplomatic, and industrial considerations that motivated European programs in the past. The fundamental obstacle is that U.S. and European codevelopment objectives generally differ and occasionally conflict. In consequence, the European strategy has not perceptibly lessened NATO R&D redundancies, encouraged cost savings, nor promoted a measurable expansion in NATO military capabilities. These, of course, are the very objectives the United

¹³For example, see *Défense Nationale*, February 1979, pp. 35-48; *International Defense Review*, June 1979, p. 92.

States hoped to attain through codevelopment. In addition, the prominence of regional political objectives and the commercial and technological rivalry with the United States associated with past European large aircraft codevelopment programs seem to militate against easy acceptance of U.S. participation in future programs. The A-300B Airbus has demonstrated that successful transatlantic commercial aerospace collaboration is feasible on the industrial level with the Europeans in the leadership position. But in the area of large military aircraft, the interests of the United States would probably be best served through the exercise of extreme caution when possible government involvement in such programs is being considered.

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