INTRODUCTION

As noted in Chapter One, interviews and recent surveys of U.S. aerospace management views point to a growing consensus that the U.S. aerospace industry must continue to “go global” and must pursue that objective much more aggressively. Yet according to these sources—and as indicated in the preceding chapter’s discussion of U.S. government reform initiatives—industry executives often remain uncertain about what strategies to pursue and continue to be concerned about U.S. government policy barriers. For example, according to one study:

Although globalization is viewed as an imperative, most [aerospace and defense] executives surveyed are still searching for the most effective way to overcome the constraints and enter new markets. Furthermore, the majority of [aerospace and defense] executives perceive their current global capabilities to be weak relative to their primary competitors. Executives [who] do have a clear picture in mind are looking to forge strategic alliances with partners overseas (Deloitte & Touche and Deloitte Consulting, 1998, p. 4).

The previous chapter discussed the extensive U.S. legal and regulatory regime that helps shape the response of the U.S. defense aerospace industrial base toward globalization. Also examined were recent U.S. government reform initiatives aimed at restructuring and
streamlining that regime. Critics contend that the existing regulatory regime, which is designed to provide technology security and to protect domestic defense industrial base capabilities, impedes U.S. industry-initiated attempts to gain the benefits of greater globalization. One important goal of DoD reform measures is to reduce such impediments. It is unclear, however, how effective these reform measures will be either at enhancing globalization or at protecting U.S. national security.

U.S. industry and U.S. government leaders alike seek to reap the greatest possible benefit from increased globalization of the U.S. defense industrial base. Yet both are entering untrodden territory, and neither is entirely sure how to proceed. This chapter reports the initial findings we derived from our survey, using open-source published materials, of 38 recent innovative approaches toward aerospace defense industry cross-border relationships. The purpose of this exercise is threefold.

First, it seeks to illustrate in more concrete detail the key characteristics and evolving nature of the major types of business relationships that have come to dominate cross-border interactions. Although all these business relationships can be categorized by means of the broad RAND typology presented earlier in this report, an examination of actual cases is necessary to gaining ground-level insight into what they may mean for the Air Force.

Second, it offers some initial insights into the factors that are promoting the creation of these types of cross-border relationships. A particular focus is whether or not the U.S. regulatory regime and the reform measures discussed in Chapter Four have positively or negatively affected the formation and functioning of such relationships.

Third, it provides an initial analysis of whether and to what extent these nontraditional cross-border relationships appear to be

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1The specific cases are listed later in the chapter. Included in this number are the complex export and import cases discussed in Chapter Two. The focus of the cases in this chapter is on industry-initiated business relationships, but other types are included as well. Changes in business relationships involving the same basic product or program and the same firms are treated as different cases. In other words, when a teaming arrangement is changed to a joint venture but the program and industry participants remain the same, it is counted as two separate cases.
promoting the overarching Air Force globalization policy objectives already discussed in this report: (1) providing affordable and capable weapon systems for the Air Force; (2) enhancing the ability of the Air Force to operate effectively in combined operations with European NATO and other key allies; and (3) protecting key national security objectives, particularly with regard to technology security and domestic industrial base capabilities.

The selection criteria for the cross-border business relationships and programs presented herein were as follows: First, most of them represent recent cross-border agreements—the majority of which are industry-initiated—that are characterized by unusual or innovative elements aimed at responding to the new imperatives of globalization. Second, most are related to aerospace combat or combat support platforms or to important munitions or command, control, intelligence, surveillance, and reconnaissance (C2ISR) programs. Many are related to the capabilities identified in the NATO DCI. A substantial number of these cases also raise unique questions or issues regarding either claimed benefits or concerns regarding globalization.

The remainder of the chapter presents detailed descriptions of most of the 30-plus cross-border business relationships and programs we examined. These cases are presented according to the broad typology of cross-border trade, investment, and other cross-border business relationships presented in Table 2.1 of Chapter Two: marketing agreements, teams, joint ventures, and parents/subsidiaries.

MARKETING AGREEMENTS

As defined in Chapter Two, marketing agreements are agreements between two or more companies to distribute an existing product—i.e., a product that has already been developed by one of the partners. Marketing agreements may include the eventual modification of the item as well as the licensed production or coproduction of the item by the nondeveloping partner.

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2A few nonaerospace defense programs have been included that exhibit great novelty or creativity in their business structures.
Although marketing agreements are sometimes components of offset agreements or are combined with other types of business relationships, the central reason for their creation is market access. Such agreements are usually made between two technologically advanced countries when market access to either country is difficult to attain without the assistance of a domestic firm. The partner that developed the item is willing to transfer technology and permit licensed coproduction by the nondeveloper partner in order to gain access to a new foreign market or to leverage existing market relationships of the nondeveloper partner. Once a sale is made, marketing agreements may be supplemented by teaming agreements or joint ventures for the production of the weapon system. Marketing agreements may also lead to teaming or joint venture agreements aimed at joint or single-party development of an upgraded version of the original item, followed by coproduction. Typical examples of recent marketing agreements are shown in Table 5.1.

**Lockheed/Rafael Popeye and Python**

Two interesting recent cases are the marketing agreement between Israel’s Rafael Armament Authority and Lockheed for the Popeye and Python 4 missiles and that between Rafael and Northrop Grumman for the Litening II targeting pod. Each of these agreements is designed to permit access to the U.S. market and to third markets through a powerful U.S. contractor. In return for certain third-country sales rights, the U.S. contractor modifies or upgrades the system, coproduces it, and markets it to the U.S. government.

A good example of this approach is the Popeye, a 3000-lb. precision-guided air-to-ground missile (AGM) that was originally an off-the-
Table 5.1
Examples of International Marketing Agreements

<table>
<thead>
<tr>
<th>Firms</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. company marketing/producing foreign-developed item</td>
<td></td>
</tr>
<tr>
<td>Lockheed/Rafael</td>
<td>Python 4 missile, HAVE NAP/Popeye</td>
</tr>
<tr>
<td>Northrop/Rafael</td>
<td>Litening II targeting/navigation pod</td>
</tr>
<tr>
<td>Boeing/IAI</td>
<td>Arrow ATBM system (negotiations)(^a)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foreign firm marketing/producing U.S. or third-country item</th>
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</thead>
<tbody>
<tr>
<td>Alenia Marconi (MBDA)/Boeing</td>
</tr>
<tr>
<td>BAE Systems/Saab</td>
</tr>
</tbody>
</table>

\(^a\)ATBM = Anti-Theater Ballistic Missile.

shelf purchase of a foreign item by the U.S. Air Force.\(^4\) Rafael developed the Popeye for use on the McDonnell Douglas F-4E by the Israeli Air Force. In the late 1980s, the U.S. Air Force viewed the Popeye as a short-term, stopgap, precision-powered munition that it could buy off the shelf from Rafael until U.S. industry developed more advanced smart munitions. Rafael worked with Boeing to qualify the Popeye for use on U.S. Air Force B-52s. The Air Force initially purchased all its Popeyes directly from Rafael as straight imports, designating the weapon the HAVE NAP and, later, the AGM-142.

In the hopes of continuing sales to the U.S. Air Force as well as to third markets, Rafael negotiated a marketing agreement with Lockheed.\(^5\) Lockheed modified the Popeye to make it more compatible with the B-52 and other U.S. Air Force platforms as well as with the U.S. Air Force logistics system. Manufacturability was also improved, and performance capabilities were enhanced through the use of a new imaging infrared seeker and an I-800 penetrating warhead. Other modifications were also made.\(^6\)

\(^4\)The Popeye was also mentioned in the section in Chapter Two dealing with trade and is discussed again in the section in this chapter on joint ventures.

\(^5\)It is possible that this was associated with F-16 offset agreements, but the open published literature does not address this issue.

\(^6\)It is unclear from the open published literature whether these modifications were conducted collaboratively with Rafael or solely by Lockheed.
On a roughly 50-50 basis, Rafael and Lockheed formed a new joint venture, the Orlando, Florida-based Precision Guided Systems United States (PGSUS) LLC, to coproduce the higher-performance version of the missile in the United States for the U.S. Air Force and third countries. This newly modified version was called the AGM-142 Raptor.

Interestingly, the formation of PGSUS appears to have led to a situation in which Rafael ended up competing against itself. When the Australian Air Force issued a requirement for a precision-strike standoff weapon, the three main contenders were the Rockwell (now Boeing) AGM-130; Rafael's Israeli version of the Popeye as a pure commercial sale; and the PGSUS LLC AGM-142 Raptor. The PGSUS LLC AGM-142 won the competition. It can be argued that Rafael's joint venture with Lockheed permitted that firm to penetrate a market it might not otherwise have been able to access without Lockheed's marketing prowess and technical upgrades. At the same time, the basic Popeye provided the U.S. Air Force and Lockheed with a product that presumably required less nonrecurring investment than would have been the case with a new start. It also broadened Lockheed's portfolio of precision-guided weapons available for export to third parties such as Australia.

The Python 4 marketing agreement between Rafael and Lockheed is equally interesting from the perspective of maintaining competition and innovation in the U.S. aerospace industry. Since the 1997 Raytheon/Hughes/Texas Instruments mergers, Raytheon has exercised a virtual monopoly on U.S. Air Force and Navy tactical air-to-air missiles. Raytheon manufactures the standard U.S. short- and long-range air-to-air missiles (the AIM-9M, AIM-9X Sidewinder, and AIM-120 AMRAAM) as well as the Navy's long-range AIM-54 Phoenix. According to credible open sources, the Rafael Python 4

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7See the discussion on joint ventures below.

8Lockheed and Rafael reportedly have also cooperatively developed a smaller version of the Popeye I HAVE NAP called “Popeye II HAVE LITE” for use on smaller F-16-class fighters. Press reports claim that Rafael has also negotiated a joint venture agreement with Turkish companies to produce and market HAVE LITE. Finally, unconfirmed press reports claim that a very long range, turbojet-powered Popeye variant labeled “Popeye Turbo” has been developed exclusively by Rafael for use as an Israeli nuclear-capable submarine-launched cruise missile.
with helmet-mounted sight is highly capable as well as competitive with the comparable AIM-9X, which has recently entered low-rate production. Although the Python 4 has not been purchased by the U.S. services, its active marketing by Lockheed may have placed significant competitive pressure on Raytheon in its development of the AIM-9X.

Rafael recently announced the development of the Derby missile, a new-generation beyond visual-range (BVR) air-to-air missile with an active radar seeker. Rafael claims that this missile provides lock-on after-launch capability as well as advanced programmable electronic counter-countermeasures (ECCM). Its manufacturer further contends that the Derby missile is competitive with the Raytheon AMRAAM and is expected to compete directly with AMRAAM for worldwide sales. Rafael claims that Derby is lighter than AMRAAM and has a more technologically advanced programmable ECCM system. See Associated Press (2001).

This is significant in that Raytheon effectively monopolizes the long-range BVR missile market in the United States. Raytheon also heavily dominates the global market, facing only minor competition from the French MICA, some Soviet missiles, and possibly Derby, at least until the European Meteor completes development over the coming decade (see below). If Rafael includes Derby in its marketing agreements with Lockheed, significantly greater competition may well be injected into the U.S. and global BVR air-to-air missile markets.

On the other hand, both the withholding and the proliferation of sophisticated air-to-air missile technology have led to political, military, and industry-related problems for the United States. Some published accounts claim that Israel launched the development of Derby because the United States denied Israel access to ECCM software technology on AMRAAM and because it had become clear that the United States was likely to sell AMRAAM to Arab countries as well as to Israel. Israeli officials were allegedly concerned that Israel could not ensure the supply of AMRAAMs from the United States in a crisis, nor did it possess the information necessary to counter

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9 Rafael claims that Derby is lighter than AMRAAM and has a more technologically advanced programmable ECCM system. See Associated Press (2001).

10 Perhaps as a counterweight to its extensive relationship with Lockheed, Rafael signed an agreement with Raytheon in mid-2001 to market its Black Sparrow medium-fidelity ballistic target missile to the United States and other countries. See Sirak (June 2001).
AMRAAMs that might be employed by opposition Arab air forces. This allegedly led to the development of Derby.

In addition, the existence of both Python and Derby means that highly advanced and capable air-to-air missiles may be proliferated to potential future opponents of the United States. According to press reports, the Chinese F-8 fighter that collided with the U.S. Navy Lockheed EP-3C Orion in early 2001 was equipped with Python 3 missiles or Chinese-manufactured derivatives thereof.

Finally, according to several open sources, Python and Derby have placed Israeli and U.S. industry into fierce competition with each other for third markets, thereby causing considerable friction between the two countries. In early 1998, after a bitter competition, the Australian Air Force selected the Matra BAe Dynamics AIM-132 ASRAAM over the competing Python 4 and the U.S. Raytheon AIM-9X. Ironically, the European ASRAAM’s highly sophisticated infrared seeker is based on U.S. technology that was transferred to the UK earlier, when ASRAAM was a collaborative program between Germany and the United States.11

Raytheon also plays a key if not dominant role in precision-guided air-to-ground munitions with major products such as the AGM-154 Joint Standoff Weapon (JSOW) and the older AGM-88 High-Speed Anti-Radiation Missile (HARM); the GBU-12 Paveway laser-guided bomb (LGB); and the AGM-65 Maverick. Boeing and Lockheed are increasingly important players as well with their GBU-31/32 JDAM and Wind-Corrected Munitions Dispenser (WCMD) strap-on glide kits for dumb bombs; Conventional Air-Launched Cruise Missile (CALCM); Joint Air-to-Surface Standoff Missile (JASSM); AGM-130; and AGM-84H Standoff Land Attack Missile—Extended Response (SLAM-ER) standoff-powered air-to-ground munitions. However, most of these munitions do not directly compete with each other. It is possible that Lockheed/Rafael’s upgrading and marketing of the AGM-142 Raptor have provided important competitive pressures

11See also Chapter Three.
that have had beneficial effects on programs such as Raytheon’s JSOW and Boeing’s upgraded versions of the AGM-130.\textsuperscript{12}

For these reasons, it would be beneficial to learn how the Popeye and Python marketing agreements as well as the Rafael/Lockheed joint venture may have affected competition and innovation in the air-to-air and air-to-ground missile markets for the U.S. Air Force. This suggests the need for further detailed investigation and case study analysis.

**Northrop Grumman/Rafael Litening II**

Rafael has also teamed with Northrop Grumman to bring a high-quality foreign product into the U.S. market that appears to have resulted in reduced costs as well as increased U.S. service and allied equipment standardization. The product in question is the Litening II targeting and navigation pod. Like the Popeye missile, the original Litening I was developed by Rafael for the Israeli Air Force. It was designed to surpass the capabilities of Lockheed Martin’s first-generation LANTIRN pods in a significant way while at the same time being cheaper, more reliable, and more maintainable.\textsuperscript{13}

In 1995, Northrop Grumman signed a marketing agreement with Rafael to upgrade and sell the Litening pod to the U.S. government and other customers. This marketing agreement designated Northrop Grumman as the prime contractor for sales to the U.S. government and called for cooperative production between the U.S. firm and Rafael. Northrop Grumman upgraded the basic Litening I pod with third-generation forward-looking infrared (FLIR) sensors and laser marker technology, software upgrades, and other improvements, resulting in the Litening II Precision Attack Targeting System (U.S. Air Force Air Combat Command, no date). The Air Force recognized that Litening II would be a low-cost means of providing

\textsuperscript{12}In terms of Air Force mission use, the AGM-142 probably competes most directly with the AGM-130. However, the AGM-142 remains the U.S. Air Force’s only bomber-qualified, conventional long-range powered standoff munition.

\textsuperscript{13}LANTIRN is an acronym for Low-Altitude Navigation and Targeting Infrared for Night. LANTIRN began development in 1980 and entered full-rate production for the U.S. Air Force in 1986. LANTIRNs were later adapted for use on U.S. Navy F-14s to provide a precision laser air-to-ground munition delivery capability.
older-model Air Force Reserve and Air National Guard F-16s with third-generation day/night under-the-weather standoff precision munition delivery capability. According to some published accounts, Air Force testing showed that Litening II provided better capability along with much-improved reliability and maintainability when compared to LANTIRN.

The Air Force purchased the pods as an off-the-shelf NDI after extensive testing and began receiving the first operational units in early 2000. Published accounts claim that Rafael manufactures the forward sensor section while Northrop Grumman manufactures the aft section with most of the electronics. It is not clear from published sources whether Rafael gained access to the technology improvements incorporated in the improved Litening II variant by Northrop Grumman; nor is it clear whether collaborative R&D was undertaken.

In July 2000, Northrop Grumman reported receiving another major Litening II contract from the U.S. Marines for use on the AV-8B Harrier. This contract also included some units for Italian Navy and Spanish Navy Harriers. In September 2001, after extensive testing on the Harrier by the U.S. Navy, Northrop Grumman announced a second Litening II sale to the U.S. Marines—a sale that was three times larger than the first.

In the late 1990s, the U.S. Air Force initiated its competitive Advanced Targeting Pod (ATP) program for the acquisition of a third-generation pod to equip F-16CJ Block 50 fighters in regular Air Force units. Because this program hopes to provide ATPs for all regular Air Force F-16 squadrons and possibly F-15E squadrons as well—and because it may eventually be used in the National Guard and Reserves—this was clearly the most important competition of all for developers of third-generation tactical fighter targeting pods. A major requirement of the ATP program was that the pod had to be already developed and qualify as NDI. Northrop Grumman, teamed

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14 Air Force fact sheets report that the Litening II pod costs $1.4 million per unit compared to $3.2 million for the LANTIRN targeting pod and $1.38 million for the LANTIRN navigation pod.

15 For example, see Clarke (1999). This is not surprising, since in many respects the LANTIRN is based on 30-year-old first-generation FLIR technology.

16 The U.S. Air Force designation is AN/AAQ-28 Litening.
with Rafael, entered its Litening II+ pod in this competition. Ranged against the Litening II+ were two formidable competitors: the Raytheon Terminator ATP, derived from the Terminator Advanced Tactical FLIR (ATFLIR), which entered development in 1997 for use on U.S. Navy F/A-18C/Ds and E/Fs; and the Lockheed Martin Sniper Extended Range (XR), which is based in part on technology being developed for the Lockheed JSF design. In August 2001, the Air Force announced the selection of the Lockheed Martin Sniper XR as the winner (Erwin, 2001; Lockheed Martin Missiles and Fire Control, 2001).

Although the Litening II lost the ATP competition, it almost certainly contributed to the intense competitive pressure placed on Lockheed Martin and Raytheon during the selection process. In addition, published accounts suggest that the Litening II program provided a low-cost, high-quality interim solution that required no government R&D expenditures while greatly improving the attack capabilities of Air Force National Guard and Reserve F-16s as well as the Marine Harriers. Furthermore, it provided for some increased cross-service equipment standardization as well as for greater standardization with at least two NATO allies that deploy Harriers. Published sources do not reveal what arrangements would have been implemented for work share, technology sharing, marketing, technology security, and third-country transfers for the Litening II. With the selection of the Lockheed Martin Sniper XR as the definitive ATP for F-16s, it is also unclear what the future role of the Litening II pods will be in the Air Force. Litening II may, however, end up competing with both the Sniper and the Terminator on international markets. Thus, although it has contributed to greater competition in the U.S. market, the Litening II pod may not promote greater equipment interoperability and standardization with allies or even within and among the U.S. services.

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17 For the use of Litening II pods in Operation Enduring Freedom in Afghanistan, see Loeb (2002).

18 The Litening has been tested by the Norwegian Air Force and is already in use by six other foreign air forces, including that of Germany.
Boeing/Alenia Marconi Systems JDAM, Hellfire/Brimstone

Marketing agreements can, of course, be put in place to access foreign as well as U.S. markets. The recent joint marketing and teaming agreement signed between Boeing and Alenia Marconi Systems, for example, is a “reverse” marketing agreement that is particularly germane to Air Force interests and objectives. Alenia Marconi Systems, which specializes in aircraft munitions and defense electronics, is a 50-50 joint venture between the UK’s BAE Systems and Finmeccanica of Italy (Hoyle, 2001). This marketing agreement appears to apply primarily to the Boeing JDAM, a low-cost guidance kit that attaches to “dumb bombs,” transforming them into Global Positioning System (GPS) precision-guided unpowered standoff weapons.19 Boeing provides Alenia Marconi with access to JDAM and derivative technology for use in the UK Precision-Guided Bomb program as well as for use in other potential markets. Boeing in turn gains access to European markets for JDAM through Alenia Marconi as well as access to the Diamond Back wing kit for JDAM.20

The two companies also plan to modify and jointly market the Boeing Hellfire anti-armor missile to fulfill the British Royal Air Force (RAF) Brimstone requirement for a precision antitank air-to-ground missile for use on fixed-wing fighter attack aircraft such as the Eurofighter.21 In our cross-border business relationship typology, this could also be considered an R&D teaming agreement, since new development work is expected (see below). Alenia Marconi in the UK will be responsible for the seeker and for final missile assembly.

By signing the marketing and teaming arrangement with Alenia Marconi, however, Boeing is not merely cooperating with an Anglo-Italian company. In October 1999, British Aerospace (now BAE Systems), Aerospatiale Matra (now part of EADS), and Finmeccanica agreed to form a joint company called MBDA that will specialize in missiles and missile systems. The company, which will be headquar-

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19See the section on teaming below for a discussion of the other teaming aspects of the agreement.
20Diamond Back is a wing developed by Alenia Marconi that attaches to the basic JDAM bomb/guidance kit combination to extend the range of the unpowered standoff munition. JDAM with the AMD Diamond Back is called JDAM ER.
21The existing Hellfire is used on attack helicopters but not on fixed-wing aircraft.
tered in London, will be formed by merging Matra BAe Dynamics (a joint venture of BAE Systems and EADS), Aerospatiale Matra Missiles (fully owned by EADS), and Alenia Marconi. Plans also include the possibility of adding Germany’s two main missile makers through a joint venture between LFK-Lenkflugkopersysteme GmbH, owned by MBDA and its parent EADS, and Bodenseewerk Geraetetechnik GmbH (BGT), owned 20 percent by EADS and 80 percent by Diehl. Also included will be a Spanish joint venture company made up of the CASA missile affiliate of EADS, as well as the Spanish-owned Indra electronics company and the Izar shipyards, making MBDA “the Airbus of the missiles business.” Press reports claim that MBDA will be close to Raytheon in missile sales revenues and ahead of Boeing and Lockheed Martin in this market segment (Taverna, 2001).

The implications for U.S. technology security and third-party transfers after this mega-merger takes place are not clear. Instead of alloying merely with an Anglo-Italian firm, Boeing will be collaborating at least indirectly with virtually every major missile company in Western Europe, including those of France, Spain, and probably Germany. The complex web of relationships introduced as a result of the marketing and teaming arrangement between Boeing and Alenia Marconi suggests that further research into this relationship is warranted.

BAE Systems/Saab Gripen

Many intra-European marketing agreements also exist. BAE Systems, for example, was an original subcontractor on the Swedish Saab JAS Gripen fighter, with responsibility for designing and developing the wing. In 1995, the two firms formed a joint venture company called Saab-BAe Gripen AB to market, modify, manufacture, and support the Gripen for sale to third countries. In 1998, BAE Systems acquired a 35 percent ownership stake in Saab Aircraft of Sweden. The UK-based company will manufacture 45 percent of the airframes of all export units. In September 2001, the two companies strengthened their marketing agreement by forming a new joint

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22 U.S. firms provide up to 30 percent of the Gripen’s content by value, including much of the modified General Electric 404 engine used in the fighter.
venture called Gripen International, headquartered both in Sweden and in the UK. BAE Systems has fully integrated the Gripen into its marketing portfolio, placing it strategically between its lower-end Hawk advanced trainer/light attack aircraft and its high-end Eurofighter Typhoon.

The impressive marketing power of this alliance, which permits package deals of a much wider variety of products from the two companies, was demonstrated when the Gripen won its first export breakthrough to South Africa in 1999. In March of that year, the South African Air Force announced a package deal for 28 Gripens and 24 Hawks. In September 2001, the Swedish/UK joint venture stunned U.S. officials with an upset victory over Lockheed Martin in the Hungarian fighter competition. It had been widely believed that Hungary would select the U.S. Lockheed Martin F-16, but the Gripen was chosen instead (Aerospace Daily, 2001). As of September 2001, the Gripen also appeared to be the probable choice for the Czech Republic and was providing significant competition for the Lockheed F-16 in the battle for modernizing the Polish Air Force fighter inventory.23

The Saab/BAE Systems joint venture marketing alliance has proven to be a powerful tool for promoting third-country sales. It has resulted in a much more serious competitor for U.S. fighter prime contractors in Europe, Latin America, South Africa, Australia, and elsewhere. More significantly, it has seriously undermined the U.S. vision for interim air force equipment standardization based on the Lockheed Martin F-16 among second-rank and new NATO members.24

23In December 2001 the Czech Republic entered final contract negotiations with Saab/BAE Systems for the Gripen.
24The U.S. Air Force long-range vision for standardization within NATO air forces focuses on the acquisition of the Lockheed Martin F-35 JSF, which has just begun its system development and demonstration phase.
TEAMING FOR CROSS-BORDER COOPERATIVE DEVELOPMENT OF NEW SYSTEMS

The RAND typology of common defense aerospace relationships laid out in Chapter Two defined teaming as an agreement between two or more companies to work together, often to pursue a specific project. Teaming is by far the most common—and perhaps the broadest—category of cross-border defense industry business relationships. Teaming agreements can cover the full spectrum of business activities shown in Table 2.2. Since there are far more examples of teaming and a greater richness in the variety of relationships, we discuss more case studies in this subsection than in any other.

For our purposes, the most revealing teaming arrangements involve the cooperative development of new systems or subsystems as well as the cross-border outsourcing of subsystems or components. Such outsourcing can involve substantial equity investment and R&D by the subcontractor, or it can merely pertain to an agreement with a subcontractor to “build to print” an item designed and developed by the prime contractor. The trend in the aerospace industry, however, has been toward the former rather than the latter.

The most comprehensive and innovative teaming agreements entail major investment and developmental efforts by the leading team members, usually for a specific project, and constitute what is generally referred to as codevelopment. Both teaming and joint venture business arrangements that involve codevelopment are among the most important types of activities for analysis not only because they are the most difficult to implement efficiently but also because they exhibit the greatest potential for mutual cross-border savings and other benefits, at least in principle.25 Theoretically, cross-border teaming for the cooperative development of major systems not only should provide the most economic benefits but should also best promote equipment standardization and interoperability, as true interoperability begins at the design stage.

Unfortunately, governments have in the past initiated many of these agreements in a manner that has undermined both their economic

\^25This is because both the development and production costs are shared by the partners, and R&D technology assets are often shared.
and interoperability benefits. Governments typically have begun
cross-border codevelopment projects by negotiating each govern-
ment’s financial contribution to R&D and the quantities of each gov-
ernment’s planned procurement of the developed item. Subsequently, government negotiators have often designated indus-
try “national champions” or key national firms that must participate
in the project team. Furthermore, governments have typically nego-
tiated and designated precise work share and work content for their
participating national industries for both the R&D and production
phases. In this context, the value of work share has almost always
been determined by the concept of “juste retour”—that is, a
participating country’s industries have received work share whose
value has been equal to the participating government’s financial
contribution to each phase of the project.

In the past, then, the entire cross-border business structure—includ-
ing the firms participating in the teaming arrangement, the work
shares, and the work content—were often negotiated by the particip-
ating governments. Broad national economic objectives, national
technology acquisition goals, and various political factors usually
played a central role. Standard commercial business practices re-
lated to relative economic advantage, such as the competitive selec-
tion of suppliers on the basis of best value, cost, and technological
capabilities, generally played lesser roles. The result was often a loss
in economic efficiency. Indeed, because of such government-
 imposed economic inefficiencies, some early European codevelop-
ment programs reportedly cost each participant more than a compa-
rable all-national program (Lorell and Lowell, 1995).

Two major innovations in cross-border business relationships estab-
lished for these types of comprehensive codevelopment teaming ar-
rangements have emerged in recent years. In the first, two or more
international teams compete for the same project. In the second,
governments grant more authority to cross-border industry teams to
negotiate the details of their own business relationships, including
the selection of team members or subcontractors as well as work
share and work content.

A variety of recent attempts to try new business approaches toward
cross-border codevelopment teaming—approaches that enhance
competition, promote best business practices, transfer more busi-
ness decision authority to the participating firms, and the like—are of particular interest for our analysis. We have divided these potential case studies into three broad categories, as shown in Table 5.2. Within those categories, there are some extremely innovative and unusual variations—such as the JSF and the XM777 ultralightweight howitzer, both discussed below. The most important of the cases have aimed at increasing NATO alliance equipment standardization and interoperability, thereby upgrading NATO European allies’ capabilities in line with the objectives of DCI while at the same time reaping the theoretical economic and technological benefits of cooperative development and production. Unfortunately, however, at this writing the most significant examples either have failed to bring about the desired results or are too preliminary to allow for definitive judgments on their efficacy.

**NATO Airborne Ground Surveillance**

In November 1995, the Conference of National Armaments Directors (CNAD) established the NATO Alliance Ground Surveillance (AGS) program. This program called for the acquisition of a core capability jointly owned and operated by NATO and supplemented by interoperable national assists. Currently, the United States is the only NATO member that possesses a highly capable fixed-wing aerial surveillance aircraft with a ground moving target indication (GMTI) radar. This aircraft is the E-8C Joint Surveillance Target Attack Radar System (JSTARS), which mounts a Northrop Grumman GMTI radar on a refurbished Boeing 707 airframe. In the 1990s, the Air Force began serious discussions with Northrop Grumman for the development of a new, more capable AESA radar and other electronics for

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26 Major past and ongoing RAND Project AIR FORCE studies examine many of the cost, budget, technical, and operational aspects of the NATO alliance airborne C2ISR problem. See Hura et al. (2000).

27 This concept draws on the precedent of a similar existing NATO AWACS program using 17 NATO jointly owned and operated Boeing E-3 Sentry AWACS. The UK and France deploy seven and four nationally owned E-3 Sentries, respectively. The U.S. Air Force has 35 in its inventory.

28 The French and Italians have fielded less capable GMTI surveillance radar systems on helicopters.
upgrading JSTARS. This program was originally known as the Radar Technology Insertion Program (RTIP).

To promote interoperability and reduce costs by increasing the production run, the U.S. Air Force and Northrop Grumman in early 1997 offered a reduced-cost E-8C JSTARS for procurement by NATO. In November 1997, the CNAD rejected the U.S. offer and requested that “fresh options” be examined. The next month, the U.S. offered a JSTARS RTIP radar on the platform of NATO’s choice. In April 1998, after an analysis of this offer, the CNAD authorized a concept definition study based on RTIP sensor technology. One year later, the CNAD authorized a two-year project definition study at a Project Definition Office in Brussels. This became an official NATO project called the NATO Transatlantic Advanced Radar (NATAR) program.

NATAR did not, however, immediately attract the major NATO European powers owing to concerns over U.S. willingness to transfer technology and the potential domination of the program by U.S. contractors, among other issues. The British never directly participated in AGS or NATAR because of an earlier decision to develop a national surveillance radar platform called the Airborne Standoff Radar (ASTOR) program, as discussed below. Instead, the leading continental European powers formed their own joint venture technology demonstration effort called the Standoff Surveillance and Target Acquisition Radar demonstrator (SOSTAR-X) program, also discussed below. Thus, although the United States encouraged all NATO members to join the program, the U.S.-led NATAR effort initially attracted only the second-rank NATO powers: Belgium, Canada, Denmark, Luxembourg, and Norway.29

ASTOR

The British had been planning a national solution to their aerial ground surveillance radar platform requirement for many years. In 1978, the British Ministry of Defence (MoD) initiated a study called the Corps Airborne Standoff Radar. In the mid-1980s, the MoD issued a requirement for a surveillance radar aircraft with GMTI and

29See more on NATAR below.
### Table 5.2  
Examples of Innovative Cross-Border Codevelopment Teaming Arrangements

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<sup>a</sup>BVRAAM = Beyond Visual Range Air-to-Air Missile; ASTOR = Airborne Standoff Radar; TMD = Theater Missile Defense; FSCS = Future Scout and Cavalry System; TRACER = Tactical Reconnaissance Armored Combat Equipment Requirement.

<sup>b</sup>Discussions of cases in the text do not follow the same order as the listing of the cases in this table.
synthetic aperture radar (SAR) modes. This eventually became known as ASTOR. As in the case of the NATO AGS program, the United States offered the UK a Northrop Grumman RTIP technology solution for ASTOR. Largely for reasons related to domestic employment and the national industrial base, however, the British MoD rejected this offer in favor of a new development program that called for a competition between two UK/U.S. industry teams—one led by Lockheed Martin Tactical Systems UK and another led by Raytheon Systems Ltd., both British subsidiaries of the U.S.-based companies. These two contractor teams received study contracts in 1995 (Worthen, 1998).

Northrop Grumman and the U.S. government heavily lobbied the MoD to permit Northrop, which had now teamed with British companies, to reenter the ASTOR competition with a new proposal based on its RTIP AESA technology. The U.S. government and the U.S. Air Force apparently hoped to reduce the costs of the RTIP program, to enhance interoperability with the UK, and to increase the prospects for the adoption of RTIP technology on upgraded JSTARS or other platforms that might be used in the NATO AGS and ASTOR programs.

In November 1998, apparently under U.S. government pressure, Northrop Grumman teamed with Raytheon (formerly Hughes El Segundo) on a 50-50 basis for the development of the radar sensor portion of RTIP, with Northrop remaining in the role of prime integrator. This may have represented an attempt to improve the prospects for ASTOR’s selection of RTIP technology, since Raytheon was a key competitor on the British program. Furthermore, Northrop began offering a scalable version of its radar array that could be mounted on smaller, business-jet-size platforms, which the Europeans preferred.

At about this time, the British relented under U.S. pressure and permitted the Northrop Grumman team to reenter the ASTOR competition. However, this was only about three months before the “best and final offers” from the competing contractors were due. The Northrop Grumman team now included numerous British members, including BAE Systems. However, the radar proposed by the Northrop Grumman team remained the Northrop Grumman RTIP technology solution funded by the United States. Some sources
claim that the British continued to encounter resistance from the United States with regard to transferring the RTIP technology to a British firm.  

In contrast, the Lockheed team proposal designated the British firm Racal (now a subsidiary of Thales of France) as the lead integrator for its radar. Ironically, Racal selected a variant of an existing Raytheon TI–developed radar—a radar based on technology from Raytheon’s Advanced Synthetic Aperture Radar System-1 (ASARS-1) used on the U.S. Lockheed U-2R—as the antenna for its radar proposal for the Lockheed-led team. The Raytheon team also proposed that a British firm, Marconi Electronics Systems (now part of BAE Systems), serve as the lead on the AESA antenna. Like Racal, Marconi selected an improved version of the ASARS-2 radar in use on the U-2R. Although the ASARS radar reportedly uses a less sophisticated passive phased array, there are plans to eventually upgrade it with an AESA. Raytheon hoped that the ASARS-2 would eventually be used on the Northrop Grumman Global Hawk UAV as well.

Interestingly, the United States is reported in the press to have already released ASARS technology to British companies. Both of the British-preferred teams, Lockheed/Racal and Raytheon/Marconi, had selected a British contractor as the prime radar integrator, yet both were planning to base their antennas on the same Raytheon ASARS technology that had already been released to the UK. Northrop Grumman, with its more advanced RTIP AESA technology, did not pick a British company to act as the radar prime integrator; instead, it elected to play that role itself, raising questions about technology transfer to the UK. The UK was thus faced with picking the more advanced Northrop Grumman technology team but having doubts about technology transfer, or picking either the Lockheed or the Raytheon team and gaining full access to Raytheon ASARS technology and future upgrades in either case. The British also allegedly expressed concerns with the Northrop Grumman offer because of U.S. restrictions on third-country sales and technology transfer stemming from the U.S. arms transfer regulatory regime.

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30For example, see Defense Daily Network Special Reports (1998).
Not surprisingly, in June 1999 the British MoD picked the Raytheon/Marconi-led team to develop ASTOR, which was to be integrated on a modified Canadian Bombardier Global Express business jet.\footnote{Twenty-five percent of the Global Express is built by Bombardier Aerospace’s Shorts subsidiary in Belfast, Northern Ireland. Bombardier acquired Short Brothers PLC from the British government in 1989.} This apparently ended the possibility of British funding of—or participation in—the U.S. Air Force–preferred JSTARS upgrade based on Northrop Grumman RTIP technology.

**Later NATAR Developments**

After the ASTOR loss, the Air Force and Northrop Grumman restructured the program and renamed it Multi-Platform RTIP (MP RTIP), implying a scalable array and radar technology that could be used on many different platforms sizes.\footnote{During the competition, as noted earlier, the Northrop Grumman team did offer an ASTOR proposal based on a scaled-down RTIP technology radar that could be mounted in a Gulfstream V business jet.} This clearly represented an attempt to keep Northrop RTIP technology in the running for the NATAR program and other foreign markets, which might be looking at business-jet-size solutions rather than JSTARS 707-class aircraft. There may also have been a concern that the British government and the Raytheon team would market their ASTOR-based ASARS-2 technology to NATO allies for the NATAR program. There was even some speculation that it could be marketed for a JSTARS upgrade.\footnote{By 1999, Raytheon was reportedly marketing an export version of its ASTOR-based ASARS-2 radar in direct competition with Northrop Grumman’s export version of its MP RTIP. See Morrocco and Taverna (1999).}

In December 2000, the U.S. Air Force demonstrated its ongoing confidence in the Northrop Grumman/Raytheon MP RTIP program for JSTARS and NATO AGS by awarding a three-year, $303 million contract for the development of three MP RTIP prototypes: the smallest for use on the Global Hawk UAV; a second version for a "wide-area surveillance platform" (a larger JSTARS-type radar); and a third to meet the NATAR requirement (Northrop Grumman Corporation, 2000). Nonetheless, DoD appeared frustrated at the apparent inability of Northrop Grumman and Raytheon to hammer out the details of their MP RTIP collaboration and present a united front to the
Europeans for a NATO AGS/NATAR solution. DoD officials appeared
determined to advocate the use of RTIP technology for upgrading
JSTARS, for the Global Hawk UAV, and for the NATAR program.
There even seemed a hope of migrating RTIP technology back to the
ASTOR program during an upgrade phase (Fulghum, 2000).

SOSTAR

The SOSTAR-X technology demonstration program was seen as yet
another major barrier standing in the way of an RTIP-based, stan-
dardized NATO AGS. SOSTAR-X is intended to demonstrate an all-
European airborne GMTI and SAR surveillance radar technology ca-
pability using an advanced AESA antenna. SOSTAR was promoted by
France, Germany, Italy, the Netherlands, and Spain as an alternative
to the Northrop Grumman RTIP-based NATAR and was approved as
an official program in 1998. In early 2001, these countries estab-
lished a joint venture consortium called SOSTAR GmbH that was
based in Friedrichshafen, Germany, and consisted of EADS/Dornier
(28 percent), Thales (28 percent), Alenia Difesa’s FIAR (28 percent),
Indra of Spain (11 percent), and Fokker Netherlands (5 percent).
One of the primary reasons for SOSTAR, according to the
Netherlands State Secretary of Defense, was that the “restrictive U.S.
export policy for defense technology would make it impossible for
European nations to gain access to all technology of the U.S. ground
surveillance radar.”34 At least some of the SOSTAR participants
claim, however, that the program is not directly competing with the
Northrop Grumman RTIP technology for NATAR but is instead
intended to give the major European countries greater leverage in
bargaining for their terms of entry into NATAR. Nonetheless, some
observers are concerned about the possibility that SOSTAR could
evolve into a European alternative to an RTIP-based NATAR or that
ASTOR could be eventually accepted as the NATO AGS solution,
leaving the U.S. Air Force standing alone with its MP RTIP program.

Northrop Grumman/EADS Strategic Alliance

One way Northrop Grumman is attempting to counter these problems with its MP RTIP technology for NATAR is through a strategic market sector alliance it has formed with DaimlerChrysler Aerospace AG. In April 2000, the two companies signed an MoU to explore the possibility of pursuing broad cooperative programs in “ground surveillance systems; high-altitude, long-endurance unmanned aerial vehicle (UAV) technology; maritime UAV technology, including real-time signal processing; airborne radar for military transport; naval radars and wide bandwidth data link technology for reconnaissance.” This is a particularly interesting teaming relationship because it encompasses entire market sectors rather than single specific projects or programs.

By 2001, the Northrop Grumman/DaimlerChrysler Aerospace (EADS) team was offering a joint transatlantic proposal to “kick start” the stalled NATO AGS NATAR program. In early June, the NATO defense ministers meeting in Brussels endorsed a NATO staff plan to merge the two competing NATO AGS programs into a transatlantic joint technological development effort. Some observers assumed that a collaborative industry effort would be built around the existing Northrop Grumman/DaimlerChrysler (EADS) relationship and a Thales/Raytheon joint venture for upgrading the NATO air defense system (Hill, June 2001).

Northrop Grumman and DaimlerChrysler (EADS) responded by signing an MoU at the Paris Air Show that was aimed specifically at working toward a common technology solution that would bring together the RTIP-based NATAR and SOSTAR programs. The MoU established a working group to jointly study a common architecture for the NATO AGS. The two firms said that the study was open to other SOSTAR and NATAR companies, including Thales and Raytheon, if they chose to join (Morrocco, 2001).

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35 This teaming relationship is expected to continue as the German company integrates into EADS.
36 See, for example, Andrews Space and Technology (2000).
37 See the section below on joint ventures.
38 The second MoU related to the joint marketing of existing and new EW systems.
The two firms also agreed to continue work on the collaborative Euro Hawk program, which envisions equipping the Northrop Grumman (formerly Teledyne Ryan Aeronautics) Global Hawk high-altitude/long-endurance UAV with reconnaissance payloads developed by EADS. While this could become an important collaborative program, it may not support the U.S. Air Force’s apparent desire to standardize JSTARS and Global Hawk with MP RTIP radar technology (Mulholland, 2001). Indeed, some EADS officials have expressed the desire for Euro Hawk to become the NATO Hawk, perhaps in competition with NATAR and SOSTAR.

**Israel Aircraft Industries/EADS UAVs**

Another complicating element is the competition posed by teams containing non-U.S. and non-European members. In the case of UAVs, for example, Israel Aircraft Industries (IAI) has also teamed successfully with EADS (France). In the past, IAI has provided UAV airframes and engines, while European firms have provided the avionics and sensors. When teamed with the French Alcatel company and other European firms, IAI sold the B-Hunter UAV to the Belgian military. The sensors and avionics of this UAV differ from those of the IAI Hunter that is coproduced with TRW for U.S. forces.

More recently, IAI has teamed with EADS (France) in order to introduce the Eagle-1 medium-to-high-altitude/long-endurance UAV to the European market. The Eagle is a modified and upgraded version of the IAI-developed Huron UAV. UAVs make up a market sector in which the Europeans remain weak, as has been emphasized by the NATO DCI. In May 2001, France chose the Eagle-1 over the U.S. General Atomics Predator used by U.S. forces. IAI further claims that it is developing GMTI and SAR radar capabilities that could be mounted on the Eagle or on modifications of that platform. Indeed, there has been mention in the press of such an upgraded platform, called the Eagle-2. Such a UAV could directly compete with either Global Hawk or Euro Hawk (Rosenberg, 2001).

It is unclear from the open literature what determined the French decision to select the IAI/EADS team, but it would not be surprising if technology transfer issues were involved. With France already deciding against Global Hawk or even Euro Hawk, this decision may make NATO RSI in this area much less likely.
Another interesting twist is that the IAI/EADS France teaming arrangement appears to be in competition with the proposed Northrop Grumman/EADS (German) proposed Euro Hawk. Which one EADS will promote most firmly remains to be seen, but the French selection of the Eagle does not bode well for NATO RSI.

The stunning complexities of the NATO AGS program—complicated as it is by the ASTOR, NATAR, SOSTAR, Euro Hawk, and Eagle efforts as well as by the Northrop Grumman/EADS strategic teaming agreement, the Raytheon/Thales joint venture, and the IAI/EADS team—make it a fascinating and potentially revealing case study on globalization trends, technology transfer issues, RSI, DTSI and DCI, and the manner in which the Air Force should try to influence such efforts. NATO AGS is also the highest-priority program in DCI, while the RTIP program is very important to the future of U.S. Air Force C²ISR. Taken together, these cases thus constitute optimal areas for further research.

NATO Theater Missile Defense

Another related and interesting industry-initiated transatlantic teaming competition recently took place with the launching of several NATO Theater Missile Defense (TMD) feasibility studies. Although the initial TMD study contracts are relatively small (standing at $13.5 million), once the development phase is initiated in 2004 they could lead to one of the largest NATO collaborative programs in history. The initial contracts essentially call for the assessment of a “system of systems” architecture. Despite the limited scope of the initial study contracts, the potentially large long-term payoff led to an intense competition between four transatlantic teams.

Lockheed, whose Theater High-Altitude Area Defense (THAAD) system and other programs are prominent in U.S. theater and national missile defense, assembled the first team, which was composed of Matra BAe Dynamics (MBDA), TRW, and several other European firms. As mentioned early, Matra BAe Dynamics is expected to merge together most of Europe’s remaining major independent missile manufacturers to become MBDA.
The New Cross-Border Business Relationships

Thales NATO Air Command and Control System (ACCS) joint venture.\textsuperscript{40} Later, a third team led (during the feasibility study phase) by Science Applications International Corporation (SAIC) was formed with Boeing, a French part of EADS, and British, German, and Dutch defense research organizations. Finally, Northrop Grumman’s Logicon division formed a fourth team.

In mid-2001, NATO revealed that the Lockheed- and SAIC/Boeing-led teams had been selected as the finalists. This paper competition will continue until the 2004–2005 time frame, when a decision will be made regarding whether to enter into full-scale development (\textit{Los Angeles Times}, 2000; Hill, May 2001). Whether or not a two-team transatlantic competition would continue after this point is unclear.

\textbf{BVRAAM/Meteor}

Two munitions programs also illustrate the problems currently confronting U.S. policymakers in promoting the NATO DCI and greater standardization and interoperability within NATO. The first is the British BVRAAM/Meteor program, which is intended to develop the main long-range air-to-air armament for the Eurofighter. The second is the Boeing/Alenia Marconi team agreement discussed below.\textsuperscript{41} Like the NATO AGS program, the BVRAAM program pitted the United States’ desire for NATO standardization and interoperability, as well as for European burden sharing of American weapon system development and procurement costs, against Europe’s desire to consolidate and develop its own indigenous industry and capabilities together with its suspicion and anger toward U.S. export policies and controls. The result was essentially a competition between a nearly all-European team and a U.S.-led transatlantic team.

On the European side, a British-led consortium was formed that was originally composed of MBDA, Alenia Marconi Systems, DaimlerChrysler’s LFK-Lenkflugkopersysteme (EADS), and Saab Dynamics. This was the European solution supported by Germany, France, Italy, Spain, and Sweden for BVRAAM. The European Meteor

\textsuperscript{40}See the section on joint ventures.

\textsuperscript{41}See also the section on marketing agreements.
consortium offered a highly advanced, new-generation long-range ramjet-powered missile concept.

On the U.S. side, Raytheon offered a time-phased program with a variety of staged upgrades to the latest version of the U.S. AMRAAM missile. The U.S. government strongly supported the Raytheon offer for reasons of standardization, interoperability, and cost sharing on further AMRAAM development and procurement. The AMRAAM is the standard long-range BVR missile on most U.S. fighter attack aircraft. The UK’s European allies, however, placed great pressure on the British government to turn to a European solution, insisting that the Meteor program was crucial both for the consolidation of the European missile industrial base and for the maintenance of advanced technical capabilities in European industry.

The competition became high profile and intense. The Europeans pulled off a coup in late 1999 by signing on Boeing to the Meteor team. This countered U.S. accusations that Meteor represented a turn toward “Fortress Europe.” Boeing’s main role on the program originally appeared to be limited to integrating the missile on U.S. aircraft and assisting in marketing efforts in the United States as well as in other countries having U.S. aircraft in their inventories. Boeing may have seen the agreement as a means of countering Raytheon’s near-monopoly on BVR missiles, just as Lockheed may have teamed up with Rafael on the Python 4 to counter Raytheon market dominance in other types of air-to-air missiles (Morrocco, 2000; Boeing Company, 1999).

A central argument made to the British government by the European team was that U.S. export regulations would permit the U.S. government to slow, delay, or block the export of the missile. The team argued that this could in effect undermine exports of the Eurofighter Typhoon itself, which would not be of much use without its missile. There appeared to many European observers to be an unacceptable conflict of interest for the Americans, since the Eurofighter directly competes with several existing and future U.S. fighters. The United States tried mightily to overcome these concerns. Raytheon, for example, recruited many European companies onto its team. The U.S. government and Raytheon eventually proposed the codevelopment of a radically new version of AMRAAM with the British acting as equal partners. In 1998, the U.S. Secretary of Defense personally as-
sured the British Defence Secretary that the United States would not unfairly block sales of the Eurofighter through withholding of U.S. BVRAAM technology.

Yet while the Raytheon solution would likely have been both cheaper and less risky from a technological standpoint, European pressure ultimately proved overwhelming, and the British chose Meteor. Some observers allege that as compensation to the deeply disappointed Americans, the British MoD decided to lease Boeing C-17s for the short-term solution to its airlift requirements, until the planned Airbus A400M military transport completed development. Some characterized this a “sop to the Americans” to compensate for the Meteor decision (Defense Systems Daily, 1999; Morrocco, 2000).42

Although the UK’s decision may have lessened the prospects for RSI within NATO on long-range air-to-air missiles, Meteor’s marketing agreement with Boeing may yet improve the competitive environment for the U.S. Air Force in this market sector. As noted earlier, Raytheon enjoys a near-monopoly on air-to-air missiles, particularly in the long-range BVR category with its AIM-120 AMRAAM. Especially if it is marketed in the United States by Boeing, Meteor could provide healthy competitive pressure. Press reports also claim that Boeing has expanded its role by engaging in studies of the development of an anti-radiation missile variant of Meteor for suppressing enemy air defenses. Such a development would provide competition to Raytheon’s HARM, which currently has a monopoly in the U.S. market (Hoyle, 2001). In addition, a Meteor-based anti-radiation missile developed by Boeing would be far more acceptable to the Europeans than an all-Raytheon proposal.

**Boeing/Alenia Marconi Systems**

As discussed earlier, the Boeing/Alenia Marconi broad-based teaming agreement may enhance competition and possibly contribute to greater standardization and interoperability in air-to-air and air-to-ground munitions. It will be recalled that this relationship includes a marketing agreement for JDAM as well as the joint modification and

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42 It is assumed that the UK will join the all-European Airbus A400M military transport program to fulfill its long-term airlift requirements.
production of a Boeing Hellfire missile variant to satisfy the UK’s Brimstone requirement. This could lead to Boeing marketing efforts to push Brimstone in the United States and elsewhere, thus possibly placing more competitive pressure on such munitions as the venerable Raytheon AGM-65 Maverick series, which has been a dominant player in the market for years. The Small Diameter Bomb (SDB) program is a U.S. Air Force effort to develop very light (in the 250-lb. class), accurate GPS/inertial navigation system (INS)-guided bombs, with later upgrades to more accurate guidance systems (Inside the Pentagon, 2001; Hebert, 2001). Under the Bush Administration, this program has grown considerably in priority; Boeing, Lockheed, and Raytheon are all interested in the effort. Two contractors are expected to be selected to compete in an initial concept development phase late in 2001. The Boeing/Alenia Marconi strategic teaming agreement gives Boeing a preexisting vehicle for entering into European and other markets if it continues in the SDB program. In principle it also gives Boeing the opportunity to leverage Alenia Marconi technologies and other resources. Additionally, it provides Alenia Marconi with potential access to an advanced new U.S. munitions program, thereby increasing the chance that the munition could be successfully marketed in Europe.

Joint Strike Fighter

The JSF program is a particularly innovative international effort by virtue of the freedom it grants the prime contractors to structure their international business relationships on the basis of their own internal business assessments. Rather than representing a full codevelopment effort, JSF could be characterized as a U.S.-led program with significant foreign outsourcing at the second and third tiers. However, major foreign team members such as BAE Systems will play important developmental roles during the system development and demonstration (SDD) phase. In addition, the JSF program concept development phase had two cross-border teams competing for the SDD contract—one led by Boeing and the other by Lockheed Martin.

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43 Formerly called engineering and manufacturing development. Foreign participants during SDD will include the UK and possibly Italy, Turkey, the Netherlands, Canada, Norway, and Denmark.
One of the most significant innovations of the JSF program with respect to cross-border relationships lies in the U.S.-UK policy dictating that foreign subcontractors must “earn” their way on the program and “earn” their work share through direct negotiations with the prime contractors. As noted earlier, government participants in traditional collaborative programs have historically negotiated work share percentages and content on the basis of government financial contribution and national technology acquisition objectives. Often governments have also designated which of their national firms must participate.44

In accordance with DoD’s acquisition reform concept of cost as an independent variable (CAIV), the JSF program has very strict average unit production price objectives. The two prime contractors, locked for four years in an intense competition for what may ultimately be the largest procurement program in U.S. history, have been incentivized to select partners and subcontractors, whether domestic or foreign, in accordance with the commercial concepts of best value and price. As a result, projected foreign industry work share does not always equal anticipated foreign government contributions.

The British government, for example, is expected to contribute approximately 10 percent of the cost of the SDD phase of JSF, but the expected value of British firms’ work share on both the Boeing and Lockheed teams is significantly greater than this. In other words, British industry is likely to get more work than it would have had in a traditional collaborative development program, where industrial participation tends to be in exact proportion to the foreign government contribution.

As a result of this novel policy, the specific British companies involved in JSF and the work tasks they undertake vary significantly between the two prime contractor teams. This is, of course, the result of the prime contractors’ and other suppliers’ having been granted the authority to determine foreign industry participation indepen-

44In Europe, this traditional approach toward collaborative development still appears to be the norm. In October 2001, for example, the eight European participants on the A400M military transport development program agreed to divide up work share in precisely the same proportions as the value of the planned national procurements of the aircraft. See Lewis (2001).
dently on the basis of their own business criteria and best business practices. The selection of foreign firms, for example, was based on best-value standards and on each team’s technical and best-value needs. Thus, the specific companies and specific work tasks vary between the two teams, but the overall foreign representation by country is roughly the same.45 This innovative approach may greatly reduce some of the economic and technical inefficiencies associated with prior international collaborative development and coproduction programs. For this reason, JSF remains an important case for further research.46

**XM777 Ultralightweight Field Howitzer**

An unusual new joint Army/Marine program is worth mention because it represents a unique situation in which a foreign-based contractor is serving as the prime contractor, developer, and integrator for an important U.S. weapon system requirement. The system is the XM777 Ultralightweight Field Howitzer (UFH), a 155mm towed howitzer that is essentially being designed and developed by a foreign-based firm to U.S. Marine and U.S. Army specifications. The prime developer is the UK’s BAE Systems RO Defence, formerly the Armaments Group of Vickers Shipbuilding and Engineering Ltd.

BAE is delivering all eight SDD units from the UK. About 70 percent of the value of the production articles will be manufactured in the United States. The U.S. firm United Defense LP will be responsible for final assembly and test for delivery to U.S. customers. The U.S. Army and Marines are slated to procure nearly 700 XM777 howitzers, while the British Army plans on buying 65 and the Italian Army 70. In short, the XM777 is essentially a critical weapon system requirement whose design, development, and integration has been awarded

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45On October 26, 2001, DoD announced the selection of Lockheed Martin as the winner of the concept development and risk reduction phase of the JSF program and awarded a contract for the beginning of SDD.

46On the other hand, while there was no formal requirement for industrial participation by firms from the countries whose governments joined the JSF program, in practice the two prime contractors knew that the inclusion of participating foreign countries’ contractors could improve their chances of winning the competition. This is especially true in the case of the UK, since the British government has a role in the final downselect decision.
to a foreign contractor because that contractor offered the best technical solution for the best price. To the authors’ knowledge, this is virtually unprecedented in the post–World War II history of U.S. major weapon system procurement (Aerotech News and Review, 2000). In addition to the economic benefits it offers, the program is clearly promoting equipment standardization with the British and Italian armies.

**FSCS/TRACER**

Most of the U.S. initiatives discussed above have shown strong industry involvement in the structuring of new forms of cross-border relationships to satisfy national technology and security objectives while at the same time maintaining or even increasing competition. The U.S. government has also attempted to proactively promote more innovative cross-border business relationships for more traditional, platform-specific programs initiated on a government-to-government basis.

The Future Scout and Cavalry System (FSCS)/Tactical Reconnaissance Armored Combat Equipment Requirement (TRACER) program is a cooperative U.S.-UK program for the development of a light armored combat vehicle, jointly called the Armored Scout and Reconnaissance Vehicle (ASRV). The effort is innovative by virtue of the actions taken by the participating governments to maintain competition in a transatlantic program in the early phases: Two transatlantic industry groups were assembled to compete during the technology demonstration/concept development phase of the program.

Of particular interest is the fact that the two groups chose to pursue different business relationships: One became a transatlantic joint venture subcontracting to a second transatlantic joint venture, while the other chose to remain a team. The first, SIKA International, is a 50-50 joint venture between BAE Systems and Lockheed Martin. It subcontracts to a second-tier joint venture called Vehicle Armour and Armament Ltd., a 50-50 joint venture between the British firm Vickers Defence Systems and the U.S.-based General Dynamics Land Systems.
The second industry group, called the LANCER team, was a prime contracting organization. Originally headed by GEC-Marconi as prime contractor, it included Raytheon Systems, Alvis Vehicles, GKN Defence, and United Defense LP. With the purchase of GEC-Marconi by BAE Systems, however, both SIKA International and the LANCER team included BAE Systems in leadership roles. This caused some concern over the competition on both sides of the Atlantic. Eventually the two governments required the establishment of “firewalls” between the two opposing BAE Systems teams.\(^{47}\) In February 1999, SIKA International won the competition to develop the FSCS/TRACER.

This program provides an interesting example of competitive transatlantic teaming using different business approaches (joint venture versus team) and illustrates one of the possible effects of a merger in the middle of the process that places the same key player on both teams. The latter situation, however, is not unique. The MEADS program, for example, has some of the same key European players on both competitive cross-border teams. In addition, the FSCS/TRACER program has evolved into a much more traditional transatlantic program since the downselect and has experienced a variety of technical, political, and funding problems. On October 16, 2001, the U.S. and UK governments officially canceled the program after joint expenditures exceeding $230 million. One published account claimed that U.S. Army requirements had changed, noting that in the future international collaboration should “take place at the subsystem level, such as engines,” rather than at the large system platform level (Barrie and Tiboni, 2001).

**JOINT VENTURES**

Table 2.2 defines a joint venture as a separate legal entity, either a partnership or a corporation, that two or more companies form to pursue a particular program or a larger market segment. While a team is usually informal and based on company-to-company MoUs, a joint venture tends to connote a deeper, more permanent relation-

\(^{47}\)With the continuing consolidation of European and U.S. industry, this is becoming increasingly common, as in the case of BAE Systems and Rolls-Royce on JSF and BAE Systems on the Medium Extended Air Defense system (MEADS) program.
ship involving more significant amounts of cross-border investment. Like teams, however, joint ventures in the defense world can be formed to conduct a range of activities, from marketing to cooperative modification or development of a single system to cooperative R&D over an entire market sector. The first two joint ventures shown in Table 5.3, discussed earlier in this chapter, began as marketing agreements and evolved into more complex and lasting relationships. FSCS/TRACER, also discussed earlier, included a transatlantic competition between a cross-border joint venture and a cross-border team for the development and production of a specific system.

Medium Extended Air Defense System

The MEADS program, which involves the United States, Germany, and Italy, is one of the earliest examples of an effort in which governments have tried to inject greater competition into international development programs through competitive cross-border industry groupings during the project definition phase. As with FSCS/

Table 5.3
Examples of Cross-Border Joint Ventures

<table>
<thead>
<tr>
<th>Companies</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pioneer UAV, Inc.(AAI/IAI)</td>
<td>Joint venture to market, modify, and coproduce Israeli UAVs for the U.S. government.</td>
</tr>
<tr>
<td>PGSUS LLC (Lockheed/Rafael)</td>
<td>Joint venture to coproduce, upgrade, modify, and market the HAVE NAP AGM-142 Raptor.</td>
</tr>
<tr>
<td>FSCS/TRACER (Sika, Inc.)</td>
<td>Joint venture in competition with a cross-border team to develop and produce a light armored vehicle.</td>
</tr>
<tr>
<td>MEADS</td>
<td>Air defense system; two competing U.S./German/Italian joint ventures established for a single program.</td>
</tr>
<tr>
<td>Air Command Systems International (Thales/Raytheon)</td>
<td>Joint venture formed to upgrade the NATO ACCS.</td>
</tr>
<tr>
<td>Thales Raytheon Systems</td>
<td>Joint venture formed to compete in a range of radar and command-and-control market sectors.</td>
</tr>
</tbody>
</table>
TRACER, MEADS also illustrates the difficulties involved even in innovative government-mandated business relationships.

The MEADS case represents one of the first times that two separate transatlantic joint ventures were formed to compete against each other for the same project. Two U.S. companies, Lockheed Martin and Raytheon, led the competing joint ventures. Interestingly, some of the key German and Italian members were the same for both teams, but different groups within each European company were “walled off” from each other in order to work with the two competing U.S. lead contractors. The Raytheon team was originally made up of a U.S. joint venture between Hughes and Raytheon called H&R Company. It integrated with a European joint venture called EuroMEADS which was composed of Finmeccanica of Italy and LFK-Lenkflugkopersysteme GmbH and Siemens AG of Germany. The Lockheed joint venture called itself MEADS International and consisted of Lockheed Martin of the United States, DaimlerChrysler Aerospace of Germany (EADS),\(^{48}\) and Alenia Marconi Systems of Italy.\(^{49}\) In May 1999, the selection of the Lockheed team was publicly announced. MEADS has, however, experienced numerous political, funding, and technology transfer disputes, and its final outcome is still in doubt.

**Thales Raytheon Systems**

The recently formed 50-50 joint venture between Thales and Raytheon, called Thales Raytheon Systems, is an innovative, industry-initiated effort to go beyond single projects and encompass entire market sectors.\(^{50}\) Raytheon’s Chief Executive Officer, Denis Ranque, has characterized Thales Raytheon Systems as “herald[ing] a new era in transatlantic relations” because it “takes us beyond a program-by-program arrangement to one that will create a long-term, stable relationship of benefit to our customers and our respective companies alike.” According to Ranque, the new joint venture “is truly a unique initiative” because it “constitutes the first transatlantic initiative to

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\(^{48}\)LFK-Lenkflugkopersysteme GmbH is now part of EADS.

\(^{49}\)As noted earlier, Finmeccanica owns half of Alenia Marconi.

\(^{50}\)Northrop Grumman’s teaming with DaimlerChrysler (EADS) is similar but has not taken on the legal formality of a joint venture.
build up a structural [joint venture] alliance in the defense sector” 

Thales Raytheon Systems grew out of a history of project-specific collaboration between the two firms, the most important of which was aimed at upgrading the NATO ACCS. In December 1996, Thales (then Thomson-CSF) and Raytheon formed a 50-50 joint venture based in Paris called Air Command Systems International (ACSI) that was aimed at winning the NATO ACCS Level of Operational Capability 1 (LOC1) improvement program. In July 1999, the NATO Command and Control Management Agency awarded the ACCS LOC1 contract to ACSI.

One and one-half years later, Thales and Raytheon announced the formation of Thales Raytheon Systems. The initial market sectors covered by the joint company are high priorities in the NATO DCI effort: air defense and command-and-control centers, ground-based air surveillance systems, and weapon-locating radars.

According to some published sources, the specific terms of the joint venture took many months to negotiate, mainly because of U.S. government controls over and concerns about technology transfer. In June 2001, however, the joint venture company announced that it had received all necessary governmental approvals on both sides of the Atlantic. The company has been structured in a manner that will help satisfy technology security concerns. Thus, for example, the joint venture company operationally consists of two subsidiaries: one in Fullerton, California, which is 51 percent owned by Raytheon, and one in Paris that is 51 percent owned by Thales. Program leadership and work are not expected to be split equally between the two subsidiaries; rather, they will be determined on a program-by-program basis. Company officials claim that there will be a free flow of information and technology within the company but that the customer will have to adhere to the regulatory regime of the country in which the lead subsidiary for a specific program resides (Lake, 2001).

Raytheon officials explicitly viewed this new joint venture company as a means of widening their market access to NATO and other European programs. Thales officials made it clear that entry into the U.S. market was their primary motivation. They noted, however, that a major advantage of a joint venture over the outright purchase of a
subsidiary in the United States was that it circumvented some of the regulatory and oversight issues involved in purchasing a fully owned subsidiary. 51 Thales officials also noted that the French company entered the British market in a similar manner, starting first with project-specific teams, then forming joint ventures, and finally proceeding with the purchase of a major subsidiary, Racal Electronics, which was one-quarter of Thales’ size. In principle, joint ventures such as Thales Raytheon could contribute substantially to NATO equipment standardization and interoperability in a variety of contexts. However, further research is necessary to determine if they will be effective in this area. Yet the Thales Raytheon joint venture is clearly one of the most innovative and unusual transatlantic business linkups in recent history, and it is in a key area stressed by DCI. It thus deserves to be a high-priority candidate for future case study research.

PARENT/SUBSIDIARY

The final category of cross-border investment and other business relationships listed in Table 2.2 is parent/subsidiary. A subsidiary is defined as an enterprise that is wholly owned or effectively controlled by a parent company physically located in another country, formed either as a new establishment or as a purchase of or merger with an existing establishment.

As discussed earlier, the most sensitive and high-profile subsidiaries from the United States perspective have historically been those that have resulted from the outright purchase of an existing U.S. defense contractor by a foreign company. The formation of such subsidiaries raises questions regarding access to U.S. classified information, technology transfer, security of supply, the investment strategy of the new foreign owners, and competition and innovation. Table 5.4 pro-

51 In a widely publicized CFIUS case in 1992, Thomson-CSF was effectively blocked from purchasing the LTV Missile Division in Texas. See Center for Security Studies (1992).
Table 5.4
Examples of Overseas Subsidiaries Acquired Through Acquisition of Existing Firms

<table>
<thead>
<tr>
<th>Companies</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rolls-Royce/Allison (1995)</td>
</tr>
<tr>
<td></td>
<td>BAE Systems/LMAES (Sanders), LMCS (2000)</td>
</tr>
<tr>
<td></td>
<td>General Dynamics/Santa Barbara ENSB</td>
</tr>
<tr>
<td></td>
<td>TRW/Lucas Verity</td>
</tr>
</tbody>
</table>

aLMAES = Lockheed Martin Aerospace Electronics Systems.

vides some examples of recent foreign subsidiaries that have been acquired through actual or attempted acquisitions.

Some OSD officials argue that there has been a “sea change” over the past decade in DoD’s attitudes toward the foreign acquisition of U.S. defense contractors.\(^{52}\) This change is illustrated by comparing the first three cases in Table 5.4.

**Thomson-CSF/LTV Missiles (1992)**

In 1992, Thomson-CSF (now Thales) attempted to buy LTV’s Vought missile division. Because of concerns over technology security, this

\(^{52}\) Based on interviews with OSD officials. Official documents, however, do not indicate such a change.
attempted purchase met with considerable opposition in DoD and elsewhere in the U.S. government. Eventually the CFIUS process produced a compromise that would in principle have permitted the purchase had it been accompanied by a strict SSA and by the establishment of a proxy firm. The conditions were so stringent, however, that Thomson-CSF withdrew its purchase offer.

**Rolls-Royce/Allison (1995)**

In late 1994, Rolls-Royce Engines made an offer to purchase Allison Engines of Cincinnati. DoD technology experts considered Allison to be a defense technology “crown jewel” because of its possession of unique, cutting-edge technologies. Much of its expertise was gained as a result of its heavy involvement, as a team member with General Electric Aircraft Engines Division, in the Integrated High-Performance Turbine Engine Technology (IHPTET) and Joint Advanced Strike Technology (JAST) programs for the development of the next-generation gas turbine engines and fighter aircraft.

It was reported that the Air Force strongly opposed the approval of this deal because of concerns that IHPTET technology would migrate to Rolls-Royce commercial engines. The Air Force argued that Pratt & Whitney could be so financially undermined in its commercial turbofan jet engine sales that it might threaten the firm’s position as a leading designer, developer, and producer of military gas turbine engines for U.S. fighters and other military aircraft. The Air Force’s position was that at least two financially healthy, robust U.S. military engine developers and manufacturers (GEC and Pratt & Whitney) were necessary for the competition to maintain innovation, quality, and price.

OSD agreed with the Air Force evaluation, but after four months of assessments it concluded that safeguards could be put in place that would allow Allison’s acquisition by Rolls-Royce to move forward. These safeguards included an SSA that imposed restrictions on uncontrolled transfers of information and technology between Allison and Rolls-Royce. In addition, programs classified above Secret, as well as the IHPTET and JAST programs, were placed in a separate, 

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53 JAST later evolved into JSF.
newly created proxy company called Allison Advanced Development Company, Inc. (AADC). This company was governed by a separate proxy agreement, separate management, and additional security procedures. Even visits between representatives of Rolls-Royce and Allison and AADC required prior approval from the appropriate authorities. As a result, Allison and AADC became wholly owned subsidiaries of Rolls-Royce.54

Five years later, OSD concluded that it had overregulated the deal. OSD determined that Rolls-Royce had acted responsibly and that the threat to Pratt & Whitney’s commercial viability no longer existed. In early 2000, DoD therefore dropped the requirement for a separate proxy company. AADC was dissolved, but an SSA remained in place. Apparently the Air Force concurred with this decision.

A key aspect of the Rolls-Royce/Allison deal was that it was the first time DoD had approved the acquisition of a “crown jewel” defense firm by a foreign company. This established a major precedent that was soon confirmed by the BAE Systems/Lockheed Martin deal.

**BAE Systems/LMAES (Sanders), LMCS (2000)**

In mid-2000, BAE Systems North America, the wholly owned U.S. subsidiary of the UK’s BAE Systems, finalized an agreement with Lockheed Martin for the purchase of its Aerospace Electronics Systems (LMAES), sector, which includes Sanders. Sanders is widely considered to be the world’s premier supplier of highly sophisticated and technologically sensitive EW equipment for combat aircraft. OSD and Air Force technology specialists clearly viewed Sanders as a “crown jewel” of the U.S. aerospace industry. Yet during the OSD and Air Force review process of the proposed purchase, there were allegedly very few major objections raised against the deal (*Aerotech News and Review*, 2000).

As one OSD official pointed out, this deal also represented a sea change when compared to the Allison deal. This time there was a clear bipartisan consensus that close allies, especially the UK, Canada, and Australia, would be permitted to buy virtually any

54See Assistant Secretary of Defense for Public Affairs (1995).
“crown jewel” of the aerospace industry with relatively few CFIUS restrictions. The BAE Systems/LMAES (Sanders) deal did not require a proxy firm as had been the case with Allison, although there were some required mitigation measures. Since the experience of Kosovo, the consequent recognition of allied technological equipment shortcomings, and the launching of the NATO DCI, a consensus had emerged within DoD that such acquisitions by close, trusted allies were desirable because they could help enhance interoperability with U.S. forces and reduce the capability gap between NATO and U.S. forces.

As a result of this acquisition and earlier purchases such as Lockheed Martin Control Systems, BAE Systems has arguably become the world’s largest defense contractor and one of the most important suppliers to DoD. This acquisition will make BAE Systems the world leader in the highly sensitive area of EW, perhaps rivaled only by Northrop Grumman.

Prior to the acquisition, Lockheed’s Sanders unit had been experiencing financial and programmatic problems with such key efforts as the Lockheed F-22 fighter program. Some observers have argued that BAE Systems’ acquisition of Sanders could strengthen the unit financially and tighten up management, providing DoD with a more capable firm and a better competitor for Northrop Grumman. Others, however, are concerned about the sensitivity of the EW technology, especially with regard to highly classified sources and methods for EW intelligence. Concerns have also been raised about what some consider to be the inflated price paid by BAE Systems for LMAES and the huge debt the British company has run up with this acquisition and others both in Europe and in the United States (Aponovich, 2000; Sirak, January 2001).

There is little decisive evidence in the open literature demonstrating that these acquisitions by foreign firms have contributed significantly to increased alliance standardization and interoperability. The principal customers of these subsidiaries remain the U.S. government, not allied governments. It is also clear that the main reason foreign companies acquire U.S. companies as subsidiaries is to gain easy access to the U.S. defense market through existing U.S. programs. Whether advanced technology is migrating to the mother companies in Europe and contributing to closing the U.S.-Europe
capabilities gap is not discernible from published sources. On the other hand, Rolls-Royce Allison is an important partner on the JSF program, providing the lift fan subsystem for the Lockheed short takeoff and vertical landing (STOVL) design and several components for the Boeing STOVL design. It could be argued that British ownership of Allison encouraged British participation in JSF and willingness to procure significant numbers of the STOVL variant, thus promoting allied equipment standardization, but this remains speculation.

Raytheon/Kollsman

Two smaller but potentially revealing CFIUS cases are worthy of relating to illustrate recent technology investment and security issues as well as to highlight the problems that sometimes arise when non-British firms enter the U.S. market through acquisitions.

The first case involves the proposed acquisition by a small company called Kollsman of two former business units belonging to Hughes Aircraft and Texas Instruments (TI), both of which were acquired by Raytheon in 1997. The government required that Raytheon divest these two units after its acquisition of Hughes and TI in order to maintain adequate competition in the defense arena in the areas of focal plane arrays (FPAs) and electro-optics (EO). The former TI FPA unit was considered by some technical analysts in OSD to be a “crown jewel.” Raytheon packaged the two units together and intended to sell them to Kollsman, its “chosen purchaser.”

OSD viewed Kollsman as inappropriate for two reasons. First, Kollsman was not seen as having the expertise or the resources to maintain cutting-edge technology development in the area of FPAs. This is because Kollsman is a relatively small company (about 600 employees and $100 million-plus annual turnover) that specializes in military laser-based EO systems and basic avionics but has little or no experience in cutting-edge FPA technology. Second, Kollsman was owned by ELOP, an Israeli EO defense firm. Some DoD officials

\footnote{In divestiture cases, “chosen purchasers” can be a DoD concern because of the belief that the divesting mother company may have an incentive to spin off the divested units to a new owner that will not pose a serious competitive threat.}
believed that the Rolls-Royce/Allison deal had established a precedent for the acquisition of “crown jewels” by the UK but not by other countries. The CFIUS process ultimately resulted in a rejection of this proposed acquisition, and Raytheon sold off the units to another company. Ironically, in 2000, Elbit, another larger Israeli military avionics firm, bought out ELOP, including Kollsman. The new, combined firm has annual revenues close to three-quarters of a billion dollars and does 25 percent of its business with DoD and 30 percent of its business with NATO and other European Union (EU) countries (Berger, 2000).

ASM Lithography Holding/Silicon Valley Group (SVG) Inc.

Another interesting case involves the difficulty that the Netherlands’ ASM Lithography Holding recently experienced in acquiring Silicon Valley Group (SVG) Inc. in San Jose, California. A number of concerns were expressed in the United States with regard to this issue, especially over the foreign acquisition of SVG’s subsidiary, Tinsley Laboratories, which manufactures high-technology mirrors and lenses for military reconnaissance satellites and other military users. For a brief period, the episode caused considerable friction between the Dutch and U.S. governments. On the basis of press accounts, however, it would appear that opposition to the acquisition came primarily from several members of Congress, not from OSD. Eventually the deal was approved. Nonetheless, because congressional actions and concerns can critically affect both the CFIUS process and the entire question of technology and arms transfer, they may warrant further examination in the context of this case or similar cases.56

U.S. FIRMS AND FOREIGN SUBSIDIARIES

Historically, U.S. companies have preferred to form project-specific cross-border teams or joint ventures with European firms rather than to acquire entire foreign companies or units as foreign subsidiaries, as it is argued that this approach provides greater strategic flexibility. In addition, U.S. firms have traditionally maintained that because the

56See, for example, Simpson (2001).
The New Cross-Border Business Relationships

European market was so fragmented, the forging of teaming arrangements and joint ventures often provided market access to more countries than the acquisition of a subsidiary in a single country (GAO, August 2000). An exception to this rule is the UK, where many leading U.S. defense contractors—such as Boeing, Raytheon, Lockheed Martin, Northrop Grumman, and General Dynamics—have long-established subsidiaries. Recently, however, the move toward consolidation of the European industrial base and the possible emergence of greater EU collaboration on requirements and procurement have led some U.S. firms to reexamine this strategy in the rest of Europe (DUSD[IA], 2001).

**United Defense/Bofors**

Bofors of Sweden and Santa Barbara ENSB (Empresa Nacional Santa Barbara de Industrias Militares SA) of Spain are two recent high-visibility European acquisitions by U.S. firms in countries other than the UK. In June 2000, United Defense LP, one of the two leading U.S. manufacturers of armored combat vehicles and naval gun systems, bought out Sweden’s Bofors Weapon Systems, a division of Saab-Celsius. Bofors is a leading European manufacturer of artillery systems, naval guns, combat vehicles, and smart ammunition. The acquisition of Bofors gives UDLP a major entrée into the European market at a time when the U.S. armored combat vehicle market is stagnant (Foss, 2000).

General Dynamics, the other major manufacturer of armored fighting vehicles in the United States, including the M-1 Abrams Main Battle Tank (MBT), followed a similar strategy through its acquisition in mid-2001 of the principal Spanish MBT manufacturer, Santa Barbara ENSB. This deal may give General Dynamics access to some of the leading European MBT technologies as well as better market access to the European market. Nonetheless, this was a controversial takeover in Europe. To seal the deal, General Dynamics

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57 General Dynamics is a broad-based multidivision firm that also manufactures naval vessels, submarines, small commercial jet aircraft, and other products.

58 Santa Barbara produces the German Leopard tank under license. The Santa Barbara acquisition was reportedly blocked for some time by heavy German lobbying
had to pledge to make a considerable investment in improving Santa Barbara’s capital assets. The deal supports the earlier acquisition by General Dynamics of a major share of Austria’s Steyr-Daimler-Puch Spezialfahrzeug AG, a privately owned shareholding company of which General Dynamics owns 25 percent. General Dynamics also has marketing and production rights for Steyr products, including the Pandur wheeled armored vehicle (Washington Post, 2001).

TRW/Lucas Verity

A major U.S. defense aerospace acquisition was completed in May 1999, when TRW acquired Lucas Verity of the UK for $9 billion. Both TRW and Lucas Verity are also major automotive parts manufacturers. In 1999, Lucas Verity logged roughly half the total sales of TRW. Following the acquisition, TRW reorganized into an automotive division with about 100,000 employees and an aerospace, defense, and information systems division of approximately 35,000 employees.

Although Lucas Verity is a typical acquisition for a U.S. defense aerospace firm in that it is headquartered in the UK, the British firm has a major marketing and manufacturing presence in several other countries in Europe and elsewhere (DUSD[IA], 2001). Lucas Aerospace, which became TRW Aeronautical Systems after the acquisition, has long been a world leader in engine controls and other sophisticated aerospace subsystems as well as in repair and overhaul. The acquisition of SAMM in France, a subsidiary of the PSA Peugeot Citroen group, made it a leading supplier of flight control actuators on the European continent. Thus, along with the United Defense acquisition of Bofors and the General Dynamics acquisition of Santa Barbara ENSB, TRW’s acquisition of Lucas Verity may suggest that U.S. firms are starting to more vigorously pursue European acquisitions outside the UK.

Nonetheless, European penetration of the U.S. defense market through acquisitions remains much more striking than the reverse. More significantly, acquisitions launched from both sides of the Atlantic appear to be driven primarily by the desire to take over an

from Krauss-Maffei Wegmann of Munich, the manufacturer of the Leopard I and II MBTs.
existing foreign national market segment as an easy means of gaining market access. It is unclear from published accounts, however, whether such acquisitions contribute in any significant way to increased equipment standardization and interoperability. The newly acquired foreign subsidiaries tend to continue to do most of their business with their own foreign national governments and to focus on their existing national or cross-national programs.

SUMMARY OVERVIEW AND FUTURE RESEARCH

The initial findings from this review of a large number of recent cross-border business agreements and other types of collaborative arrangements are as follows:

- U.S. aerospace defense contractors are much more active and aggressive than has previously been the case in initiating cross-border business relationships on the basis of their own internal business and market calculations.

- Many of these relationships are innovative and vary from the types of business relationships—often imposed by governments—that were typical in the past.

- The extent to which the regulatory environment and the ongoing reform of that environment are influencing these new types of industry-initiated cross-border business relationships is not fully discernible from the published literature, but that influence appears to be significant.

- In-depth analysis of the relative advantages and disadvantages, from the Air Force’s perspective, of the various types of new industry-initiated cross-border relationships cannot be fully discerned solely on the basis of the published literature.

- Further detailed research focused on primary source case studies and interviews with relevant industry and government officials is necessary to gain the information required to formulate policy options for the Air Force on optimally managing the new types—and greater numbers—of industry-initiated cross-border relationships.
We believe that field research based on interviews with relevant government and industry officials both in the United States and abroad, combined with in-depth case analyses of a carefully selected number of case studies, could fill the gaps in our knowledge and support the formulation of meaningful policy recommendations for the Air Force.

On the basis of an initial review of the wide number of cases discussed in this chapter, we find that the types of programs that realistically appear to show the most promise for promoting the potential military-political and economic benefits of globalization are those that have some or all of the following characteristics:

- They are voluntarily structured and sometimes initiated by defense firms rather than by governments on the basis of internal business calculations of market conditions and best business practices.
- They are painstakingly structured to satisfy the existing U.S. arms export and technology security regulatory regime and CFIUS.
- They often focus on promoting existing products or modifications thereof or on specific product market sectors.
- They often focus on subsystems, munitions, or discrete components or areas rather than on large, complex programs for the development of entire weapon system platforms.\(^{59}\)
- They are designed to gain and expand active reciprocal market access through new programs.
- They are often motivated by a desire to add to a company’s product portfolio a highly competitive product in a market sector dominated by another firm or firms. Thus, they inherently promote greater competition.

\(^{59}\)Following the cancellation of the U.S.-UK FSCS/TRACER program in October 2001, one journalist noted that the program “highlighted many of the pitfalls of trans-Atlantic cooperation at the platform level” and reported that a senior British official observed that “in the future, collaboration at the subsystems level might be more fruitful.” See Barrie and Tiboni (2001).
They are characterized by mutual perception of balanced and complementary bilateral market access opportunities and technology transfer.

For further research, we suggest an examination of case studies for in-depth analysis to better illustrate the issues and problems involved with greater globalization, as well as the menus of policy options the Air Force has to manage them.

Two proposed case studies are shown in Table 5.5. These cases illustrate many of the most important emerging trends in cross-border business relationships as well as some of the formidable barriers and issues that must still be overcome if the U.S. Air Force is to realize the potential benefits of globalization. The first is the Northrop Grumman/EADS (Germany) market sector teaming arrangement for Global Hawk/Euro Hawk, EW, radar, and other product sectors. The second is a broader study of the overall NATO AGS program.

The two central questions we seek to answer in any follow-on research are as follows:

First, what types of new industry-initiated cross-border business relationships and cross-border activities are most likely to promote the claimed benefits of globalization?

- Greater competition in the interests of encouraging technological innovation and reduced equipment procurement costs to the Air Force;
- Greater cross-border procurement RCI with key U.S. allies;
- Achievement of the goals and priorities laid out in the NATO DCI; or
- Protection of key national security interests regarding technology transfer, security of supply, and R&D investment?

Second and most important, what “lessons learned” will provide the most guidance to the U.S. Air Force on how to effectively promote procurement efficiencies and achieve greater interoperability with our allies while protecting vital national security interests?
### Table 5.5
**Case Studies of Cross-Border Strategic Market Sector Collaboration**

<table>
<thead>
<tr>
<th>Program</th>
<th>Business Structure</th>
<th>Activity</th>
<th>Competition&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Globalization Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance radar, command and control</td>
<td>U.S. French market sector joint venture</td>
<td>Codevelopment, coproduction</td>
<td>Variable</td>
<td>Tech transfer, tech security, work share, NATO RSI&lt;sup&gt;c&lt;/sup&gt; competition</td>
</tr>
<tr>
<td>NATO alliance ground surveillance</td>
<td>To be decided</td>
<td>Codevelopment, coproduction</td>
<td>Euro Hawk, ASTOR, SOSTAR, Eagle+, NATAR&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NATO RSI, tech transfer, tech security, interoperability</td>
</tr>
</tbody>
</table>

<sup>a</sup>The "Competition" column indicates separate programs that are clearly in competition. See the main text for a detailed discussion of specific programs.

<sup>b</sup>ASTOR = Airborne Standoff Radar; SOSTAR = Standoff Surveillance and Target Acquisition Radar; NATAR = NATO Transatlantic Advanced Radar.

<sup>c</sup>RSI = rationalization, standardization, and interoperability.

We believe that further in-depth case study analysis of the types of cases listed above, along with more extensive interviews of relevant government and industry officials, will fill the gaps in our research to date and help us answer our basic policy questions for the U.S. Air Force.