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Echoes across the Pond:
Understanding EU-US Defense Industrial Relationships

5 August 2009

by

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This report represents the authors' efforts to provide a useful, albeit partial, understanding of the international defense marketplace – which we view as changing toward increasing complexity. In pursuit of that objective, we provide a brief overview of international defense markets in the context of both changes in military affairs and the various defense industrial bases.

In analyzing the defense market, we essay multiple analytical frameworks (along the lines of *Essence of Decision*). Our analytical models are (a) a sophisticated view of offsets in a public policy context with market imperfections, (b) transaction cost economics with our unit of analysis being the nation-state instead of the firm, and (c) two standard corporate strategy models.

To test the models' explanatory powers, we consider three ongoing "cases": F-35 Joint Strike Fighter, the UK Defence Industrial Strategy, and the Northrop Grumman-EADS KC-30 proposal. Interestingly we find all three hypotheses have some explanatory power, but none of the three is demonstrably better than the others (in this small sample).

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Keywords: Industrial Base, Transaction Cost Economics, Corporate Strategy, Offsets, KC-30, F-35 Joint Strike Fighter, UK Defence Industrial Strategy

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I. Introduction

This report represents the collective efforts of the three authors to provide a useful, albeit partial, framework for understanding an international defense marketplace that we view as quite complex and as becoming more so. As a start, we have chosen to focus on the defense markets and defense industrial bases in the United States and the European Union. This is hardly a complete picture. A number of major defense suppliers are operating outside those groupings to varying degrees. The other players include great powers such as China, India, Japan, and Russia. A complete list would likewise include smaller, but nonetheless very competent, defense suppliers from Australia, Brazil, Israel, Norway, South Africa, South Korea, Sweden, Taiwan and Turkey. Nonetheless, the United States and the EU are presently the leading centers of defense production—both in technologies and sales. As such, they constitute reasonable subjects with which to start this line of inquiry.

More specifically, our basic aim is to provide: (a) an interpretative narrative of major developments within the global defense marketplace, (b) a set of explanatory paradigms to make sense of those developments, and (c) an exercise of those paradigms within the context of three ongoing "cases" in the international defense trade. Accordingly, Section 2 below discusses the ongoing revolutions in military affairs (theirs and ours), major trends within the global defense market, and major developments more specifically within the US and EU.

Section 3 provides our interpretative paradigms. It starts with the idea of using multiple models to understand complex events.[1] However, we offer: (a) a rather sophisticated and nuanced view of offsets, (b) Transaction Cost Economics (TCE), and (c) corporate strategy (Five Forces and "Co-opetition").

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[1] This is associated primarily with Graham Allison's "essence of decision" approach to analyzing the Cuban Missile Crisis of 1962 (Allison, 1971; Allison & Zelikow, 1999).

Section 4 integrates major trends in the defense market position (Section 2) with the models presented in Section 3. In particular, we consider three ongoing developments that we believe encompass the major developments and issues in the international defense market: the Joint Strike Fighter consortium, the EADS (and Northrop-Grumman) KC-30 proposal, and the UK's Defence Industrial Strategy.

Finally, Section 5 assesses our models' explanatory powers and offers some additional observations on the current state of US-EU defense markets and defense industries.

II. Major Developments in the International Defense Marketplace

As indicated above, we believe that the international environment for both production and trading of defense goods is steadily becoming more complex. Accordingly, our first task is to offer our views of some of the more important ongoing developments in the marketplace. Section A below discusses changes in the means of warfare. In particular, we believe that two revolutions in military affairs (RMAs) are currently underway. One is associated with developments in precision and net-enabled warfare led by the United States and its allies. The other belongs to contemporary insurgent and terrorist organizations, such as Al Qaeda. In a very real sense, the second RMA is intended to counter the first. Also ongoing are countermeasures to the terrorists' methods by the US and others. Some of the implications for defense industries are also discussed.

Section B covers other developments, especially globalization and economies of scale in military production. The world's economy is becoming more global; equivalently, national economies are becoming more interdependent. This makes self-sufficiency in any major economic endeavor, including defense production, increasingly problematic. It is likewise increasingly difficult to efficiently produce military systems within national borders, while simultaneously relying upon sales to the domestic defense establishment. One result is the ongoing systemic tension between the need for defense industrial capabilities (as part of national sovereignty) and the economic imperatives of the global defense marketplace.

More specifically, Section 2.C assesses current US and European defense industrial developments. We believe the major themes in these developments are industrial consolidations and defense industrial strategies (generally implicit), formulated as matters of both national policy and corporate planning.

A. Two Revolutions in Military Affairs

Contemporary military affairs illustrate rapid changes in both military technology and the art of war.[2] That is, new technologies and methods are not merely changing wars, but changing the ways wars are fought. The ongoing Revolutions in Military Affairs (RMAs) have both created new military competencies for successful innovators and decreased significantly the operational effectiveness of previous methods. The 1991 and 2003 encounters of the Iraqi armed forces with US (and allied) forces illustrate the point well. However, military success is always fleeting, and a counter-RMA associated with contemporary terrorists such as Al Qaeda is a serious effort to do the same thing to contemporary US (and allied) forces.

A revolution in military affairs is usefully defined in a number of ways. One (attributed to Cohen) is a dramatic change in warfare in which the measures of military power change significantly. Another (from CSIS) is a fundamental advance which renders existing methods of warfare obsolete.[3] Still another emphasizes the role of disruptive innovation, which renders at least one core competency of opponents obsolete or irrelevant (Franck & Pierce, 2006).

RMAs can be characterized by foundations, preferred modes of operation, relevant combat organizations, and ideal (or perfect opponents). The foundations are typically found in technologies, which are applied to a well-defined mode of warfare.[4] Associated also are preferred modes of operation.[5] Additionally, the new methods are incorporated into an organizational framework. Finally, full

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[2] Although some observers have perhaps overstated the case (e.g., Owens, 2000), there is, nonetheless, good reason to believe that contemporary RMAs are indeed revolutions in the means and art of warfare. The rapid changes in the art of war have also changed defense industries.
[3] The Cohen and CSIS definitions are cited and discussed in Franck and Hildebrandt (1996, p. 240).
[4] Both aspects are important. The German victory over France and Britain was not a matter of better tanks; it was that German tanks were organized in formations intended to achieve operational disruption, while France and Britain organized their tanks into formations intended to support the "deliberative battle" (an improved version of the trench warfare of World War I).
[5] Generally codified as "doctrine."

understanding of any RMA entails the opponent against which the new approach was intended to work—the "perfect opponent" (Franck & Pierce, 2006).

1. Our RMA

The US-led RMA was originally conceived as a way of countering Soviet-style mechanized warfare in the latter decades of the Cold War.[6] The technical foundations involved a cluster of inventions, most notably the microchip, that made information processing both rapid and cheap. The military applications of the new technology were found first in communications, sensors, information fusing, and precision weapons. This RMA, developed primarily in the United States, was structured to counter a massive mechanized offensive—such as the one the Soviet Army (and *Warsaw Pact* allies) could have mounted against NATO forces in Germany.

The organizational embodiment has been well described as a Reconnaissance-Strike Complex (RUK)[7]. First combat for a fully realized RUK occurred in the Gulf War of 2001 (Franck & Hildebrandt, 1996). However, demonstrations ("precursor wars") were evident in the interdiction campaigns in Southeast Asia (1968-1972) and Israeli air operations against Syrian forces in Lebanon (1982).

2. Their RMA

A separate Revolution in Military Affairs was in progress by the 1990s—associated with contemporary terrorist organizations such as Al Qaeda. This Counter RMA drew upon insurgency warfare methods developed by Mao, Giap and others. It also incorporated the technologies and methods of the rapidly developing information economy. In particular, contemporary terrorists draw heavily upon internet communications to coordinate operations.

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[6] The Soviets were likely the first to fully grasp the significance of the nascent RMA.
[7] A term translated from the Russian literature, as discussed in Franck and Hildebrandt (1996).

Therefore, we believe the foundations of the Terrorist RMA are composed of information technology applied to well-established models of insurgent and terrorist warfare. Preferred modes of operation involve tactical invisibility, operational initiative and strategic patience. What this RMA adds to traditional insurgent and terrorist methods is a third, "virtual" domain—units and operations linked and coordinated through cyberspace. Domains of military operations are summarized in Table 1 below.

Domain	Mode of Operations	Nature of Operations
First (separated)	Combatants separate and deliberately recognizable	Overt Physical
Second (embedded)	Combatants disguised within general population	Covert Physical
Third (virtual)	Combatants linked in cyberspace	Covert Virtual

Table 1. Domains of Warfare (a Contemporary Terrorist View)
(Franck & Pierce, 2006)

These RMAs are not independent events. Just as the US-led RMA was a response to Soviet methods, the terrorists' RMA is a response to current US methods. A scheme for understanding the competitive nature of RMAs is offered in Franck and Hildebrandt (1996). In particular, they provide a classification of countermeasures for those wishing to compete against a successful military innovator (such as the United States); these are summarized in Table 2 below. Basically, "emulating" measures are intended to counter new capabilities using the same basic methods as the enemy. "Offsetting" measures aim to negate the new capabilities using different methods. Finally, "bypassing" measures aim to make the new capabilities irrelevant or obsolete through a new set of capabilities. In general, RMAs generally consist of bypassing responses to an existing (generally dominant) military system.

Emulation	Mirror Image (highly similar forces and modes of operation)
	Substitution (equivalent capabilities through different means)
Offset	Defense (minimizing effects of opposing forces)
	Disruption (dislocation of opposing operations)
Bypassing	Avoidance (rendering opposing capabilities irrelevant)
	Leapfrogging (making opposing capabilities obsolete)

Table 2. Classification of Military Innovations in Military Competitions
(Franck & Hildebrandt, 1996; Franck & Pierce, 2006)

3. Our RMA vs. Theirs

A comparison of the two ongoing RMAs is displayed in Table 3 below.

	RMA	
	Ours (US and others)	Theirs (modern terrorists)
Technical Foundations	Information Technology (especially as applied to communications and precision strike "kill chains")	Information Technology (especially as applied with the Internet)
Area of Application	High-intensity conventional combat	Insurgency Warfare Terrorist Operations
Preferred Modes of Operations	High-speed, precise, operations at tactical and operational levels. Quick victories	Tactical Invisibility Operational Initiative Extended strategic timeline
Perfect Opponents	Soviet-style mechanized forces	Liberal Democracies

Table 3. Comparison of the Contemporary Revolutions in Military Affairs
(Franck & Pierce, 2006)

With the increase in speed and accuracy of information transfer (and methods for translating new information into new practices), the art of war has entered a period of hyperadaptivity. Knowledge of new enemy tactics can be rapidly disseminated to friendly forces, with a view to more quickly finding successful countermeasures. Likewise, friendly forces can rapidly receive news of their own best practices (including successful countermeasures). Accordingly, US forces have

undertaken a large and diverse set of measures to counter the new terrorist capabilities. And, as stated above, these methods' foundations are a combination of new technologies and older counterinsurgency methods.[8]

However, as the US introduces countermeasures, the terrorists find and employ counter-countermeasures. A significant part of the current rivalry involves a clash of competitive strategies. The terrorists wish to impose a model of labor-intensive warfare, while the US seeks to counter in its tradition of capital-intensive warfare. Thus, for example, terrorists prefer combat operations in built-up urban zones, with protection from US firepower afforded by buildings and the civilian population. US-style forces' counters include improved sensors (such as very small reconnaissance UAVs), as well as more precise and low-yield weapons (such as the Small-Diameter Bomb).

The general US intent is, therefore, usefully understood as an effort to apply technology- and capital-intensive solutions against a labor-intensive opponent. Thus, the new generation of land combat vehicles is a defensive counter to IEDs. The large-scale deployment of long-endurance reconnaissance (and sometimes strike) airborne vehicles is intended to disrupt terrorist insurgent operations with near-continuous presence of highly sophisticated sensors to deprive terrorists of their "cloaking" modes of operation (Seifert, 2007).

4. Implications for Defense Industries

These rapid changes in the means of warfare have changed the defense marketplace and can be expected to continue doing so. Some of those effects can be associated with the US-led RMA, some with the terrorists' Counter RMA.

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[8] Professional military reading for the US military now includes works such as Horne, Small Wars Manual. Alastair Horne, *A Savage War of Peace: Algeria, 1954-1962* (rev. ed.), NY: Penguin Books, 1987. United States Marine Corps, *Small Wars Manual*, Washington, DC: U.S. Government Printing Office, 1940.

Some Changes Due to Our RMA

The progression from platform-centric (systems) to network-centric (systems-of-systems) warfare has likely accelerated the trend toward increasing complexity of military hardware. Integrating the functions of new platforms (e.g., F-22 and DD-1000) has itself become increasingly difficult. However, there is a new dimension to this problem—integrating also a diverse set of military systems into a well-functioning Reconnaissance-Strike Complex (system-of-systems). The difficulties that have attended the US Navy's cooperative engagement projects and various efforts to integrate the various parts of Ballistic Missile Defense complexes illustrate this point—even though they are arguably relatively small-scale compared to the Owens task of dominant awareness of a 200 nautical mile cube (Owens, 2000).

Coincident with the new RMA is an era in which platforms look very much like "decadent technologies."[9]. That is, improvements to platforms themselves are likely to come at very high cost and to have diminishing operational impacts. Tactical fighters provide a useful example. What would have previously been regarded as very old airframes, such as the F-15 and F-16, are considered front-line combat aircraft, and are still strong candidates for countries seeking to purchase new aircraft. For example, the F-16, a relatively old design, is still surprisingly attractive for those in the market for a first-rate fighter aircraft.[10] We may, in fact, be entering an era in which tactical fighter aircraft (to take one example) wear out before they become obsolete. The recent F-15 grounding over concerns about structural integrity illustrates this point.

Also, fighters with the most significant additions in capability—such as the F-22 Raptor (stealth) and Su-37 Bearkut or Flanker-F (maneuverability)—feature very high development and acquisition costs. And the F-35 Joint Strike Fighter, a

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[9] The term "decadent technology" is associated with Mary Kaldor (1981), and is discussed more formally in Franck (1992). Mary Kaldor, *The Baroque Arsenal*, New York: Hill and Wang, 1981. Raymond E. Franck, *Cost-Performance Choices in Post-Cold War Weapon Systems*, Maxwell AFB, AL: Air University Press (AU-ARI-CPSS-91-11), Feb 1992.

[10] Pierre Tran, How France's Rafale Lost Morocco Sale, *DefenseNews*, 15 October 2007. Lockheed Martin to meet deadline for India's war jet deal, *AFP News*, 3 November 2007.

somewhat stealthy tactical fighter, has encountered significant increases in unit costs—even though it was originally represented as a relatively unambitious design that would fit into the defense budgets of many nations.[11]

Accordingly, we may well be entering an era of recapitalization (replacement) for a wide variety of military platforms—as opposed to modernization through increased capability. Two useful examples of "long service before obsolescence" are the US Air Force F-16 Falcon and the KC-135 Stratotanker. The KC-45 program (in its current form) is more a hedge against KC-135 airframe aging than an embodiment of operationally significant, new technology. Furthermore, the Boeing KC-767 and Northrop Grumman-EADS KC-30 (the KC-45 competitors) offered fewer advances in capability relative to the current mix of tankers (KC-135s and KC-10 Extenders) than the KC-135A provided relative to the KC-97 Stratotanker and KB-50s (tankers modified from the B-50 Superfortress bomber). The F-16 continues to improve, but those enhancements are completely invisible to most outside observers. F-16s are acquiring new capabilities through improvements in subsystems and the increased ability to engage in network-enabled combat operations.[12] Moreover, the F-16 continues to compete well in international sales—as the recent cases of India and Morocco illustrate.

Some Changes Due to Our RMA vs. Theirs

Changes in methods of warfare have, not surprisingly, implications for defense industries. For example, mine- and IED-protected land combat vehicles have become major (and high-profile) defense acquisition projects. Previously, the emphasis lay more with the aerospace sector. This was true both in projects and in methods. It was no coincidence, in our opinion, that Boeing (an aerospace company) was chosen to be project lead for the US Army's Future Combat Systems

[11] JSF design philosophy is discussed in more detail below.

[12] This is not completely new, as the many incarnations of the B-52 well illustrate.

(FCS) project. It is likewise no coincidence that combat vehicle purchases (such as MRAP(Mine Resistant Ambush Protected) vehicles) are of more traditional types.

This change in the composition of demand for military hardware has potential for changing the structure of defense industries; new products are luring new firms into the defense market. Thus, for example, there were only two serious proposals for the new US Air Force KC-45 aerial tanker—both of which come from well-established defense industrial forms and one of which includes an airframe designed abroad. In contrast, proposals for a new robot for combat operations have come from a number of companies, the majority of which are not among the major defense industrial firms.

Finally, initiatives with the US DoD to field combat systems faster indicate (perhaps) an impetus toward major changes in business methods. Counters to a hyperadaptive opponent indicate rapid implementation of new military solutions. The hyperbureaucratized nature of the US defense acquisition process is directly at odds with the need for rapid change associated with these developments. It's reasonably safe to predict this disconnect will be a continuing source of stress for all suppliers of military establishments, such as the US DoD.

B. Developments in the Global Defense Marketplace[13]

As noted in the section above, defense industries worldwide are in an extended period of continuous, perhaps revolutionary, change. The end of the Cold War in 1989 and the dissolution of the Soviet Union in 1991 certainly caused major changes in the market for military goods and services. But still greater changes were due to defense acquisition reform, the Revolution in Military Affairs (RMA), the onset of information-age economies, globalization of economic activity, and the Counter RMA highly visible after September 11, 2001.

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[13] This section is, in many respects, an updated version of an unpublished manuscript, Raymond E. Franck, *Recent Developments in the Global Defense Marketplace*, unpublished manuscript, August 2001.

However, it's difficult to judge relative importance because these developments are closely related. For example, the same basic technology underpins both the contemporary RMAs and information-age business practices. Information-age business, in turn, facilitates global commerce. The RMA was a major contributor to the difficulties that ultimately doomed the Soviet Union (Becker, 1987). The application of Information Technology (IT) to commerce has facilitated the long march toward economic globalization. The Counter RMA associated with organizations such as Al Qaeda likewise exploits IT.

1. Acquisition Reform

Defense acquisition reform, particularly in the US, has been largely a consequence of the information age and the end of the Cold War. With Warsaw Pact threats no longer at the center of military planning, it was clear that major reductions in industries supporting the military establishment could, and should, happen. Moreover, with the rapid and extensive commercialization of IT, the role of the defense sector had changed considerably. Defense was no longer a technical leader producing "spinoffs" for the rest of the economy. Defense was now just another player in a very large market for IT products—especially important for military purposes because of the US-led RMA. Moreover, the military sector has frequently been a "late adopter" or even a laggard in exploiting IT developments. This sluggishness was, at least in part, due to the procedural and regulatory apparatus inflicted upon the defense acquisition process (most notably the DSARC, Defense Systems Acquisition Review Council process and its later avatars), plus the *Federal Acquisition Regulation* (*FAR*)). It was, therefore, clear that the US defense establishment would have to reconsider its methods of purchasing as well as the scale of its business.

During the Cold War, the sluggish West had the good fortune of facing opponents who were comparably sluggish; those days are over. The issue of slow, plodding responses to threats has taken on particular significance in the Global War on Terror (GWOT). The US and its allies now face flexible, opportunistic opponents–who are willing to switch weapons, modes of engagements, strategies,

and (stated) political goals in order to win. (Hammes, 2004) On our side, we observe processes of acquisition and strategy formulation that are highly bureaucratic, legalistic and politicized.[14]. Appropriated monies remain unspent; IED countermeasures lag enemy tactics because of devotion to bureaucratic punctilio (or "worship of process").[15]

While various types of rapid fielding initiatives have been in place for some time (e.g., the purchase of GPS sets for OPERATION DESERT STORM ground combat operations), it's not clear that these new efforts constitute the seeds of meaningful reform. It's not clear that rapid fielding and the rest of the DoD acquisition system have yet worked out the modalities for coexistence.

2. Globalization: Prosperity at a Price

A period of economic growth that has been remarkable both for its length as well as resilience began after World War II. In general, an epoch of "unrivaled prosperity" featured growth of international commerce that encompasses an ever-increasing fraction of economic activity (e.g., Dornbusch, 2000). While it was a major cause of growth and prosperity, expanding international trade has, by its very nature, increased economic specialization among nations. This has proven an especially sensitive issue when interdependence means loss of self-sufficiency in military production.

3. From Problem to Fact

The rising tide of international trade and global markets threatened and then overwhelmed any realistic prospects for autarky in defense—even for the United States, where the situation was certainly taken seriously by the 1970s. Arguably, the condition had passed beyond remedy even then. When dependence on foreign suppliers first attained visibility as a policy issue, it was regarded as a problem,

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[14] Franck & Pierce, 2006.

[15] Those who make rapid decisions must consider the prospect of facing those who can audit at leisure.

perhaps a crisis, to be remedied. A number of measures were seriously studied in the 1970s and 1980s; the aims of these included: (a) preserving domestic capabilities in certain key components, like semiconductors, and (b) restricting foreign defense purchases to firms in politically reliable nations.

Nonetheless, the foreign supplier "problem" continued. Indeed, the end of any close resemblance to defense self-sufficiency in the United States had ended before the Cold War did (Kapstein, 1992). While the Warsaw Pact had a largely self-contained defense industrial complex, self-sufficiency turned out to have been achieved at a very high price. Their defense products were increasingly unable to keep pace with the ongoing RMA.

With self-sufficiency diminishing, if not vanishing, in the industrial democracies and discredited in the Soviet bloc, interdependence in the defense sector came to be regarded by most as simply a fact of life. At present, foreign suppliers are pervasive at the component and subsystem level. It's also clear that foreign sources for both sub-systems and platforms are now a matter of routine. While some resort to the international marketplace is due to offset agreements and similar arrangements, globalization would likely have made international supply chains inevitable in any case.

4. From Fact to Opportunity

With global downsizing of defense production after the Cold War, it became increasingly difficult to have meaningful competition for contract awards within national borders. Dealing with only one supplier is considered unacceptable because of the obvious loss of bargaining advantage and lack of incentive for innovation. A generally accepted corollary is that dealing with two suppliers is problematic for similar reasons. There is no credible threat to let any one firm fail (which would lead to the unacceptable state of only one supplier). Therefore, it would seem that the minimum acceptable number of firms for any major defense product is three firms (Rogerson, 1998).

The problem is that with scarcity of new production contracts (caused, *inter alia*, by funding declines and unit cost increases), the market simply cannot support a base with: (a) a competitively attractive number of suppliers of (b) economically efficient size, and (c) within national borders, even US borders. The United States, for example, could look to several credible sources for new fighter aircraft in the early 1980s: General Dynamics, McDonnell Douglas, Northrop and Grumman—with Lockheed. Martin, Fairchild and Boeing as potential players also. After the downsizing, only two domestic firms (Lockheed Martin and Boeing, after acquiring McDonnell Douglas) could offer a credible proposal for the F-35 Joint Strike Fighter (JSF). This is a serious problem for defense acquisition planners.

In recent years, US policy makers have begun to regard globalization as a tool for solving that problem. Foreign suppliers are to be regarded as full-scale candidates for prime contracts for major systems. The EADS/Airbus consortium (with Northrop Grumman as its North American partner) was encouraged to offer a proposal for a new US Air Force aerial tanker, which won the competition in March 2008..

5. From Opportunity…to Problem

What's stated above is a reasonable characterization of defense market globalization, particularly as viewed in US policy circles. However, defense production isn't just another item of international commerce. Defense industries are especially important to their nations. The rise of the nation-state in Europe (codified in the Treaty of Westphalia in 1648) was, in a very real sense, a result of military revolutions of the 16th and 17th centuries, which led to economies of scale for nation-states in providing for defense (Krepinevich, 1993; Parker, 1996). This implies a special status for the capacity to produce military goods within national borders—that arguably goes directly to the fundamental character of the nation-state. Hence, even that radical free trader Adam Smith acknowledged defense production as a special case for self sufficiency in the *Wealth of Nations* (Smith, 1776).

The result has been a certain ambiguity in many nations. While there's a consensus in favor of free trade on both a regional and global basis, there are strong reservations about extending that regime to military goods and services. Kapstein (1992) provides an excellent characterization of this attitude:

> states have had an ambivalent relationship with the international economy when it comes to matters of national security. With the development of the state system in the seventeenth century, and the military revolution that coincided with it, rulers increasingly felt the need to maintain in their grasp at least some war-fighting capability. This meant having a pool of trained men, *along with industries capable of defense production, within the borders of the state or its imperial reach*. (p. 21, emphasis added)

What this means is that the logic underpinning the growth of international trade in general is much less compelling for military goods. Calculations of most efficient supplier will not likely be compelling in "make or import" decisions for military equipment. For a number of reasons, including sense of nationhood, governments can be expected to favor domestic sources in various ways.

Even if military hardware is imported, purchasing nations will frequently insist on "offsets" (or similar arrangements) to accompany imports of military equipment. Those offsets generally (but not always) involve some benefit for the indigenous military-industrial capability. They are frequently some combination of component or sub-system purchases, shared production, licensed production, or technical transfers.[16]

A corollary to the need for domestic defense industries is a need for export sales. Very few national military establishments can generate sufficient orders to sustain a weapons source of efficient size in any category. The clear implication is that globalization in defense industries will not follow the same trends seen in other

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[16] Offsets can take other forms as well, such as purchase of nonmilitary goods from the buying country. Likewise, they can serve a number of purposes besides enhancing domestic defense industries. Udis & Maskus (2001), for example, argues that offset arrangements can, and do, constitute a means of circumventing protectionist legislation (e.g., *Buy American* requirements and French industrial policy).

areas. It's reasonable to expect that there will be more firms making military hardware than standard calculations of market size would indicate, with that extra capacity being the direct result of national defense and industrial policies.

It's also reasonably safe to predict that international military commerce will be perpetually subject to what economists generally call non-tariff barriers. Arms exports will remain increasingly tied to special arrangements between buyer and seller. This is not new. But there are features in the contemporary defense marketplace which accentuate the importance of those arrangements. First, there has been a general problem of overcapacity in the defense industries following the Cold War. For the reasons described above, arms-producing countries have been reluctant to shed excess capacity. At the same time, successfully modernizing countries (such as Turkey and South Korea) have shown increasing interest in domestic defense production capabilities.

Finally, it is entirely possible that firms having a substantial stake in defense exports will strive to preempt these trends through acquisitions and strategic partnerships involving foreign arms concerns—and through other means described in Bitzinger (1998).

6. Bottom Line: Some Systemic Tensions

These developments (both new and continuing) have produced a number of systemic tensions in the defense marketplace. Basically, the Westphalian ideal of defense industrial capacity as both manifestation and bulwark of national sovereignty has been in a period of long-term decline. On balance, there's good reason to believe the disparity between the sovereignty ideal and the industrial realities will continue to increase. This has a number of implications:

Defense industrial capabilities will be maintained, and indeed developed, for reasons other than the likelihood of profit. New great powers such as China and India are likely to continue to develop significant domestic capabilities. Similar initiatives can, likewise, be expected from successfully modernizing regional powers such as Brazil, Turkey and the Republic of Korea.

It's reasonable to expect that the logic of nationhood will lead to some forms of compensation for imported arms. While these have traditionally been in the form of offsets, the game is getting more complicated—to include more emphasis on industrial participation, licensed production, technical transfer, and other forms of long-term relationships among defense industrial firms. Securing appropriate levels of national control will be an important part of defense policy for many arms importers, including the United States. It will also be a key policy foundation for nations such as the United Kingdom—a discussion to follow in this report.

Likewise, long-term overcapacity will lead to highly competitive efforts to secure Foreign Military Sales (FMS) In particular, European firms are highly dependent on exports. This export imperative will drive extraordinary efforts to win sales.[17] At best, we'll see an interesting buyers' market. At worst, the global defense trade could become a zero-sum scramble for defense industrial sovereignty.

C. Current US and European Defense Industrial Developments

This section describes the current state of the US and European defense industries. One of the difficulties attendant to making such a comparison is defining what constitutes "Europe." One could use the 27 members of the European Union (EU), for example, but that would exclude Norway, a member of the North Atlantic Treaty Organization (NATO) and a growing armaments producer. Including only the 23 European members of NATO would exclude Sweden, a traditionally neutral country but that is closely linked to Europe through significant arms purchases and sales and membership in the EU. Accordingly, we have chosen to follow the (variable) definition of "Europe" provided in our source materials, with remarks as necessary to include clarification.

[17] For example, EADS' efforts to overturn C-130 sales to Canada by appealing to the parliamentary opposition. David Pugliese, EADS Tries to Block Canada's C-130 Buy, *DefenseNews*, 17 June 2007.

Table 4 provides a general perspective on the relative size of the world's largest weapons producers; six are headquartered in the US, and four are in Europe. The most recent available data from the Stockholm International Peace Research Institute (SIPRI) indicates that 40 US companies represented 63% of the combined Top 100 arms sales of $290 billion in 2005. Some 32 "West European"[18] companies accounted for another 29% of world armaments sales (SIPRI, 2007). With respect to sales of weapons, the European aerospace and defense market is considered to represent sales of $234.9 billion; while the US aerospace and defense market has been estimated at $502.6 billion[19] (Datamonitor, 2006a; 2006b).

The above figures and Table 4 illustrate a few preliminary thoughts, which we will discuss further below. First, when Europe is viewed as a group of countries (even though the choice of exactly which countries varies), the overall size of its defense market and armaments firms are smaller than the US, but not dwarfed entirely by the latter. Integration among European firms, as shown by the creation of Munich-based EADS, a Franco-German-Spanish company, creates economies of scale and scope that give these entities a better opportunity to compete both at home and worldwide. Furthermore, EADS is the sole owner of Airbus, giving it some of the benefits of combined military-civil synergies that Boeing and other US firms have long enjoyed. During 2006, 24% of EADS' sales were to the US and Canada, a figure which includes Airbus (Masson, 2007, p. 6).

[18] SIPRI does not define which countries are included in this region.

[19] This estimate defines Europe as consisting of Belgium, the Czech Republic, Denmark, France, Germany, Hungary, Italy, the Netherlands, Norway, Poland, Russia, Spain, Sweden and the United Kingdom.

Table 4. Top Ten Largest Arms-producing Companies, 2005
(SIPRI (2005), cited in Jones (2006, p. 263)

Company	Country	Arms Sales (US$ Millions)
Lockheed Martin	United States	24,910
Boeing	United States	24,370
Northrop Grumman	United States	22,720
BAE Systems	United Kingdom	15,760
Raytheon	United States	15,450
General Dynamics	United States	13,100
Thales	France	8,350
EADS	France, Germany, Spain	8,010
United Technologies	United States	6,210
Finmeccanica	Italy	5,290

EADS' military sales to North America have been rather limited in the past. That said, should the KC-30 tanker/transport (which uses the Airbus A330 as a platform and is a joint venture with Northrop Grumman) survive the current bid protest by Boeing and be purchased by the US Air Force, then EADS' sales and presence in the US will increase significantly.

The largest European defense firm, BAE Systems, represents a more Atlanticist approach to arms sales. In 2006, 40% of the firm's sales were to the US and Canada, with a stated goal of 50%; the firm already represents one of the six largest suppliers to the US Department of Defense (DoD). Furthermore, the firm is a model of vertical (as well as horizontal) integration, having absorbed almost the entirety of the United Kingdom's storied aircraft industry—with BAE being the largest non-US participant in the F-35 Lighting II Joint Strike Fighter (JSF) program. The company's strategy of a significant presence within the US became evident in 2005

when BAE acquired United Defense, well known for its armored vehicles, followed by its purchase of Armor Holdings in 2007 (Masson, 2007, pp. 7-8).

Similar strategies of consolidation have created the remainder of the firms listed in Table 4. Thales is notable as a merger of a large number of French defense electronics companies and has become a leading supplier of software-defined radios to the US DoD, with an initial contract stated by the DoD to be worth $3.5 to $9 billion (Taverna, 2007). Finmeccanica's Alenia is partnering with L-3 Communications and Boeing in the $2.04 billion DoD acquisition of the C-27J Spartan tactical transport aircraft (Gettle, 2007); the airframe will be an adaptation of an Alenia commuter aircraft. Finmeccanica is also acquiring British defense-related firms. One French study suggests two main reasons for Finmeccanica's strategy: first, in order to have UK-based facilities that will qualify under the UK Defence Industrial Strategy (UK Ministry of Defence, 2005); and second, as an indirect entry to the US-UK "perimeter" that has been established recently.[20]

Within that perimeter, the export and technology control policies of both countries have been significantly relaxed (Bruno, 2007). The same study suggests, however, that the price of Finmeccanica's acquisitions may be a loss of collaborative European business (Masson, 1997, p. 36). France's somewhat autarkic attitude is perhaps also understood when it is noted that the country has stated its desire to remain the world's third largest arms exporter, with €4 billion in exports in 2005. However, the new President of France, Nicolas Sarkozy, has launched a wide-ranging consultation and policy development exercise on defense and national security, including industrial base and procurement issues (Conseil économique et social, 2007; Premier Ministre, 2007).

In reviewing the differences in weapons procurement, some attention should be paid to the relative size of the US and European economies as well as of defense spending. Using 2006 data, the US and the 27 nations of the EU have about the

[20] The UK Defence Industrial Strategy is discussed in more detail in Section 4.C below.

same GDP (€11,860 billion vs. €12,140 billion respectively), while US defense expenditures are about twice those of the EU (€404.4 billion vs. €213.1 billion). Not surprisingly, defense spending as a percentage of GDP follows the same pattern, about 3.4% in the US vs. 1.8% in the EU (Conseil économique et social, 2007).

The above data demonstrate that the US spends more on defense in both absolute and relative terms. Yet, as shown in Table 4, the major European defense firms are quite large, and as discussed above, "Western European" firms represent 29% of global arms sales (SIPRI, 2007). It is, therefore, inevitable that exports and multinational collaboration are more important for European firms, given the relative paucity of domestic defense budgets.

However, it should be emphasized that US defense spending has risen rapidly since the attacks of 11 September 2001, and the subsequent invasions of Afghanistan and Iraq. While European nations (and weapons) have participated in both conflicts, EU countries have not shown the capability to increase their spending to anything approaching the current US level, which can be informally estimated to be about $700 billion annually. The informed observer would also note substantial downstream costs to repair or replace large quantities of US military equipment ahead of schedule due to damage and unforeseen rates and types of wear in a predominantly desert environment.

1. The "Last Supper" and US Consolidation

Certainly, the post-Cold War era has ushered in a wave of consolidation as well as unprecedented transatlantic industrial partnerships. Contrary perhaps to received wisdom, it is difficult to state that the US and European defense industries are developing as parallel "fortresses." It appears rather that firms and governments on both sides of the Atlantic are pursuing strategies that integrate autonomy and interdependence. We will delve into how the current situation came about.

Jones (2006) has suggested that considerable evidence exists that EU states are gradually building a "strong and integrated defense industrial base." In addition to increasing their ability to compete with (and collaborate with) the US defense

industry, European firms are also reacting to post-Cold War changes in the US defense industrial base.

Hensel and Wood (2007) have noted that the number of large US defense contractors (defined as those who collectively supply over 70% of the DoD's needs) has consolidated significantly—from 17 in 1989 to 5 in 1997. The authors also found that 1529 US defense mergers had been announced between June 1978 and June 2005.

It would be logical to conclude that the US consolidation reflected in Table 4 was due to the search for economies of scale and scope in a technologically sophisticated industry, driven (*inter alia*) by the need to integrate hardware and software into increasingly complex systems.

During the 1990s, there was also a general trend toward reduced defense expenditures, with policy makers pursuing the hoped-for "peace dividend" associated with the end of the Cold War. In a somewhat unusual action within the US government, the Secretary of Defense (Les Aspin) and his Deputy (William Perry) held a private dinner in 1993 for the heads of major US defense contractors (referred to by some authors, perhaps inappropriately, as "The Last Supper"). After the dinner, Aspin and Perry encouraged many of the existing firms to leave the DoD market, with a warning about decreasing procurement budgets and the need for economies of scale to maintain global competitiveness (Jones, 2006; Skapinker, 1999). This government "suggestion," rare in a capitalist society but perhaps appropriate given the DoD's effective monopsony, may have encouraged the wave of US defense industry mergers and acquisitions that followed during the second half of the Nineties (Skapinker,1999; Van Scherpenberg, 1997). One could also venture to suggest that Aspin and Perry foresaw the effects of the European defense industry developments, resulting from the establishment of the EU.

Of course, at the time of the "Last Supper," the tragic events of 11 September 2001 had not yet occurred, nor had the "Long War" (or Global War on Terrorism) yet begun. These events have since led to a significant increase in US defense

expenditures, as well as significant procurement spending by the Department of Homeland Security (DHS), created in 2003 as a result of the 11 September 2001 attacks. The now larger, integrated US defense contractors that survived the Nineties found themselves well positioned to supply the Long War (also fought by US allies, including Australia, Britain, and Canada) and to meet the needs of the DHS. These events were definitely not factors envisaged as the Berlin Wall fell or when the "Last Supper" was held.

Jones (2006) also suggested that the end of the Cold War led to a significant decline in (a) transatlantic collaborative projects, as well as (b) transatlantic mergers and acquisitions, accompanied by an increase in these two types of activities within both the US and the EU. However, a more comprehensive study for RAND by Lorell, Lowell, Moore, Greenfield, & Vlachos (2002, pp. xxi-xxiii) determined that:

- Numerous innovative cross-border strategic market-sector agreements initiated by US and foreign companies are emerging.
- Consolidated European and other foreign firms mean potentially more equal partners, as well as stronger competitors.
- European and other foreign firms view the acquisition of US firms as the most effective means of penetrating the US market.

The above authors went on to suggest (p. 183) that a small number of case studies be selected in order to determine patterns of collaboration among US and European firms.

2. The Dangers of Reductionism

We are struck by the challenges inherent in undertaking quantitative analyses of the defense industries on both sides of the Atlantic. Accordingly we have reservations about the likely results of any such studies and resulting policy recommendations. We hope that we have made clear that there is a large, worldwide defense industry dominated by the US and Europe. An independent French research organization recently conducted a study of the current state of the European defense industry (Masson & Paulin, 2007). The study was requested by

the French defense ministry and covers 188 closely spaced pages and thousands of firms, financial transactions of all kinds, codevelopment, coproduction and other types of mutual agreements and government acquisitions of military systems. All of these are occurring between the 27 EU states, the US and Canada, as well as the rest of the world.

We wondered what the authors, having catalogued and discussed this tidal wave of activity, would conclude. Understandably perhaps, no quantitative analysis was done. The study, on its last page, moved from data collection to one paragraph of analysis and three recommendations, which are summarized as follows:

The EU should be responsible for a policy framework on issues such as transfers of people, the standardization of practices such as bidding, and managing the convergence and commonality of certain defense and security requirements and systems.

Bilateral or multilateral agreements between individual EU member states should cover exploratory research and development. Production should be performed within the 27 member states, while favoring management of the acquisition process by the European Defense Agency (EDA).

National governments should remain responsible for sovereignty-related issues, regulation of financial markets and corporate activities, as well as defense employment, foreign defense equipment imports, and minor projects. (pp. 185-7)

The above statements link well with the French government's use of the EU as a mechanism for leveraging Europe to support French sovereignty. Part of France's goal in this regard is the almost continual promotion of the EU as an emerging military coalition with the capability to deploy forces, ostensibly at UN request (Permanent Representation of France to the European Union, 2006).

However, France continues on the parallel course of promoting exports of strictly French products, as seen during an attempt to sell the Dassault *Rafale* to Morocco, which eventually chose the Lockheed Martin F-16 Falcon. Despite the

Rafale's much higher cost and complexity that were perhaps a little too much for Morocco's limited needs, France pushed the sale very hard, given that no exports have yet materialized for this advanced aircraft (El País, 2007a).

French policy, taken as a whole, appears to be substantially different from the more Atlanticist and domestically oriented UK *Defence Industrial Strategy* (UK Ministry of Defence, 2005). As we will discuss, the British approach parses the spectrum of defense systems and defines with a reasonable level of clarity where the boundaries between independence and collaboration or dependence lie. Furthermore, the UK and France differ significantly in their perception of the role of the EDA as a supplement to or replacement for national decision-making.

Yet it is significant that even such major policy differences have not precluded the two countries from collaborating on a major binational project: the joint development and construction of three aircraft carriers with a "Common Baseline Design" (UK Ministry of Defence, 2007): two for the UK and one for France. The UK government will pay approximately €2.85 billion to build each carrier, while the French ship will cost about €2.5 billion. BAE, Thales, and the French-government owned DCN are the main contractors involved.

Each country will equip its carrier with distinctive national systems as well as aircraft. The Royal Navy will use the F-35 Joint Strike Fighter (once that aircraft replaces the Harrier GR7 or GR9), and France's *Marine nationale* will use the Dassault-built *Rafale* (currently entering carrier service on the *Charles de Gaulle*) as their fixed-wing combat aircraft. Interestingly, the future French vessel will continue to feature three Northrop Grumman E-2C Hawkeye surveillance aircraft onboard.

Finally, in order to make the project practical in terms of cooperation with the UK, the French president decided to revert to conventional propulsion for the new carrier—unlike its nuclear-powered predecessor, the *Charles de Gaulle* (Marine nationale, 2007; Masson & Paulin, 2007, p. 187). The Royal Navy uses nuclear propulsion only aboard submarines. The above example demonstrates the sheer difficulty of attempting to discern any common strategic policies on armaments

between the UK and France; their strategies appear both opportunistic and practical, neither of which is a criticism.

The more limited study by Lorell et al. (2002), having briefly reviewed 25 collaborative projects between the US and European nations, came to some preliminary conclusions (see the above section of this paper), but recommended the need for detailed case analyses of two such projects in order to form a basis for eventual policy recommendations. Vlachos-Dengler (2002, p. xi), in a study of European defense industrial capabilities, came to the following conclusion: Structural relationships between players are extremely complex, justifying their being characterized as "the European spaghetti bowl." There is a multitude of cross-shareholding relationships, joint ventures and consortia, often formed around specific programs but occasionally evolving into more permanent structures.

Robert Trice (2007), Senior Vice President, Business Development of Lockheed Martin, presented the relationships between US, European, Israeli and Asian firms in a similar way, with a diagram showing a large number of linkages related to a few projects. In Trice's view, even this limited set was too complex to categorize. Trice also makes the following recommendation directed at governments: "Engage industry to promote a common understanding of defense and civil gov't strategies and acquisition objectives." Vlachos-Dengler (2002, p. 170) concludes her review by discussing the results of the above trends:

> It is interesting to note that consolidation in the European defense industry may have produced one of the least efficient market structures for that industry because an oligopolistic market structure, such as the one it currently has, tends to produce more excess capacity than either a monopolistic or competitive market. At the same time, those firms that have remained in the defense industry have become much larger, with more-specialized weapons systems integration capability, and they will compete fiercely with their rivals to produce the next generation or leading-edge weapons systems.

As a result, governments inadvertently may have found a replacement for the technological competition of less-concentrated market structures—the intense

oligopolistic competition among the high-technology defense contractors committed to supplying the most advanced weapons worldwide.

III. Analytical Frameworks

As indicated, we began this study with the hypothesis that offsets (even in more complex and sophisticated forms) have become less useful in understanding international trade in defense products. If so, one possible line of research is to develop complementary models to clarify the complexities of the contemporary defense market, especially its international dimensions.

Accordingly, we begin with a discussion of analysis with multiple models (Section A). A natural starting point for this methodology is Graham Allison's use of multiple explanatory models to explain the complex events of the Cuban Missile Crisis of 1962 (Allison, 1971; Allison & Zelokow, 1999). Section B presents the offsets perspective of international defense trade.

Section C presents a summary of the Transaction Cost Economics (TCE) theory of enterprise behavior. TCE was developed first as a means of studying the "vertical" boundaries of firms.[21] For purposes of our current inquiry, we extend the basic TCE perspective by viewing nation states as defense enterprises—whose preferred mode of operation is a vertically integrated defense establishment (military forces and associated defense production capabilities).

Finally, we present a corporate strategy perspective based on the Five Forces and "Co-opetition" (Section D). Among other things, this permits exploration of our hypothesis that defense industrial firms are, for a number of reasons, becoming more important players in the global defense market.

[21] Vertical boundaries of a firm refers basically to how much of the supply chain is subsumed within the firm. Thus, for example, an automobile manufacturer that includes a tire-making division is vertically integrated. Closely related subjects are the intricacies of the "make-or-buy" (or outsourcing) decisions, as well as the gains, peculiarities and difficulties associated with outsourcing relationships.

A. Analysis with Multiple Models

The systematic use of multiple explanatory paradigms to analyze complex situations is generally associated with Graham Allison's *Essence of Decision* (1971; Allison & Zelikow, 1999). Allison applied this approach the problem of explaining the Cuban Missile Crisis of 1962. He introduced three separate explanatory models (I, II and III) as means to better understand the decisions made by the major players—both the US and Soviets.

Model I's unit of analysis is the unitary rational actor; who operates on the basis of well-considered decisions in pursuit of his interests.[22] Model II, Organizational Processes, focuses (not surprisingly) on organizations and their operation through established processes. Model II seeks to understand the dynamics that result from organizations seeking to exercise their established (and preferred) modes of operation. Model III considers agencies within the context of a larger organization containing a number of similar agencies; it emphasizes the interaction of these agencies. Those interactions may be rivalrous, cooperative, or some mixture of conflict and collusion. Model III is, therefore, termed "organizational politics."

Associated with each model is a set of key propositions, a propensity to pose a different set of questions and arrive at a different set of answers to any given question. Allison characterized the three separate perspectives as follows.

Model I: National policy is viewed as the result of the deliberations leading to rational choices.[23] Decisions are therefore usefully understood as the results of assessing available policy alternatives against national objectives and resources available. Basically, policy can be explained (and predicted) by careful consideration of the rational course of action, given objectives and circumstances.

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[22] Originating basically in standard microeconomics.

[23] Basically applied microeconomics.

Model II: Policy is the result of the operation of various organizational processes—understood through appropriate consideration of organizational components, functions and modes of behavior (standard operating procedures and organizational repertoires). Policy, therefore, arises from organizational context and organizational reaction to the situation presented.

Model III: Policy is the result of interaction and bargaining among various organizations within the government. Model III explanations involve consideration of relevant players, what shapes their opinions and positions, and the nature of the arena ("action channel") in which this interaction takes place.

The *Essence of Decision* methodology features separate applications of the various models to the understanding of complex situations and events. "Because simplifications are necessary, competing simplifications are necessary" (Allison and Zelikow, 1999, p. 8). In short, complex phenomena are best understood when viewed from a number of well-defined perspectives. The analytical messiness arising from use of "multiple, overlapping and competing conceptual frameworks" is an acceptable cost when weighed against the enhanced understanding possible with these multiple models.

Proceeding from the basic assessment above, we intend to apply multiple models to understanding our defense industrial "cases" later in this report. However, our menu of models is not the same as those used to understand the Cuban Missile Crisis. Our set of explanatory paradigms consists of Offsets in defense industrial practice, Transaction Cost Economics, and standard models of corporate strategy—as discussed in the sections following.

B. Offsets and International Industrial Participation

While we started this effort with reservations about offsets as a comprehensive paradigm for understanding international defense trade, we also understand the model's usefulness in explaining contemporary events. There is a rich and longstanding literature on offsets in international defense trade—coupled

with an extensive body of practical experience. Doing justice to the offsets model accordingly entails the detailed (and relatively lengthy) exposition that follows.

1. Offsets: Definition, Goals and Theory

Offsets in international defense trade became ubiquitous in sales of technologically advanced equipment beginning in the late 1960s and early 1970s. The most common offset agreement commits the selling firm to perform some non-market requirement as a necessary condition for the sale. Such requirements vary widely, ranging from an agreement by the seller to purchase products and/or services from the buying country essentially unrelated to the equipment sale being negotiated, to explicit transfer of technology, investment, and various co-production arrangements. Commitments involving work by industry of the buying country on the product whose sale is being negotiated are described as direct offsets, while other unrelated arrangements are known as indirect offsets.

Some observers have likened offsets to barter, but this view is misleading. In the view of a careful student of the offset phenomenon:

> The concept of added reciprocity is central to the practice. This is the notion that the transaction should create some economic activity over and above that which would occur if it were only a cash transaction. That is, the purpose of counter-trade [offsets] is not to avoid the use of cash for an exchange of goods or services; rather, it is to have some added impact or effect beyond the exchange of goods per se. (Hammond, 1990, p. 5)

Since such transactions occur outside conventional market operations, many economic theorists stamp them as trade diverting and, hence, welfare reducing. This position has been repeatedly uttered and has almost assumed mantra-like quality. The “diversion” refers to the forceful twisting away of the terms of a transaction from those likely to have evolved optimally in a competitive market, usually as a result of monopoly influence. The applicability of the familiar efficiency argument for a simple market exchange is based upon the assumption of a competitive market structure. The imperfectly competitive nature of the aerospace industry opens the likelihood of oligopolistic market distortions, resulting in resource misallocation under free trade. Under such circumstances, trade or industrial policy

may be introduced to counter such distortions in what may be reasonably described as a second-best case.

In the defense case, the buyer is a government agency, again suggesting that the assumptions of market competition may be misapplied. Additionally, economists have usually concentrated on a single goal in identifying an optimal policy—with limited, if any, attention focused on other goals in the social calculus of public decision-making. Multiple policy objectives which characterize real-world decision-making by government officials convert a theoretically optimal policy for the attainment of a single goal into a mutually contradictory mélange.

Practical realities often require policy makers to adopt a broad approach to the selection of programs that advance simultaneously several objectives in a somewhat consistent way, while steering around the several political and economic constraints that narrow the range of available alternatives. In such an environment, offsets may indeed offer a relatively safe route through a dangerous mine field, or, in technical terms, an efficient contract. Such multidimensional contracts challenge the popular theoretical view that all dimensions can be translated into money at a common and objectively determined rate in a competitive market. Thus, the emergence of a lower price for the buyer may not automatically prove to be the optimal solution.

In an international market for advanced technology products, participants face uncertain product quality, imperfect competition, and a complex contract-enforcement climate. In such an environment—one with substantial inhibitions to the unfettered use of price variations to adjust to changing conditions of supply and demand—bargaining is a natural development.

Several distinguished economists have recognized these developments; a sample of their views may prove instructive. Williamson has commented on the tendency of orthodox economists to see nontraditional modes of organization and contracting as proof of attempts to monopolize rather than simply to economize on transaction costs (Williamson, 1985). Recent growth in the arms trade, information

technology, and training has led Michael Intriligator (among others) to suggest that analysis may have to proceed beyond traditional classical theories that evolved in a world of trade in basic commodities (Intriligator, 1987, pp. 364-369).

Goals: Since offsets are usually demanded by the buyer, focus on goals will here be limited to the perspective of the buyer. Historically, a wide array of goals has been reflected in offset negotiations. A study of offset terms reveals such objectives as economizing in the use of what may have appeared to be scarce foreign exchange; providing jobs and production for domestic labor and industry (and, simultaneously, a defense against attacks from domestic political foes for enriching foreigners at the expense of citizens); acquiring valuable technology and training that will advance the competitiveness of local industry and perhaps spread from the defense industry to the broader economy; and a means to circumvent foreign "buy-national" requirements and, thus, enhance the export potential of domestic industry. The popularity of these goals has changed over time and space, varying with such factors as foreign exchange rates, perception of national security environment, level of industrial development, level of economic growth, offset experience, etc. The diversity of such goals and the factors influencing them make any effort to evaluate their results and impact in the aggregate most difficult. However, given the widespread appearance of technology acquisition in offset history, it may be useful to examine the theory of technology transfer to understand why the offset model appears to be a convenient avenue to consummate such transfers.

Critics of offsets often ask why such a desire to acquire advanced technology isn't addressed more directly through purchase of the technology in the market rather than through the more circuitous route of participating in an offset arrangement. In an important article, Teece has criticized the portrayal of the firm by traditional microeconomic theory as an abstract bundle of productive transformations. He objects to this conceptualization, since it implies a firm's

behavior as stored in symbolic form in “a book of blueprints” (Teece, 1982, pp. 39-63, especially p. 43).[24]

Teece challenges this “book of blueprints” metaphor, stressing the tacit nature of much individual knowledge that can be articulated only with difficulty. He observes “in the exercise of individual skill, many actions are taken that are not the result of considered choices but rather are automatic responses that constitute aspects of skill” (1982, p. 44). When transferring this concept from the individual to the routine operations of a business organization, “much that could in principle be deliberated is instead done automatically in response to signals arising from the organization or its environment” (p. 44). Thus, organizational memory exists, and it is based on routines. Members of the organization must be able to receive and interpret information arising from within the organization and its environment in order to trigger an appropriate response from their “repertoire.” Since technology transfer between firms involves a shift across organizational boundaries, the transmission of an individual’s knowledge of a routine separated from its context may be unsuccessful.

Even if one assumes that both parties are aware of the opportunity to gain via exchange, and buyers acknowledge the existence of valuable information for which they are willing to pay, much more than a “simple” market exchange is usually necessary. As already noted, the exchange of technology has powerful tacit and “learning-by-doing” characteristics, which often require that individual and organizational knowledge and experience accompany the transfer of purely technical information and data. Open reciprocal information is necessary both to identify and disclose opportunities which may exist for the exchange of information as well as to aid the actual transfer. The parties in such a situation are linked in what Williamson has labeled a “small numbers trading relation,” which carries risks for both parties arising out of strategic manipulation of information or misrepresentation of intentions

[24] The original conceptualization is found in Winter (1982, pp. 55-91, especially p. 58).

(Williamson, 1975, pp. 26-28). Specific examples include a "seller exposed to hazards such as the possibility that the buyer will employ the knowledge in subtle ways not covered by the contract, or the buyer [leapfrogging] the licensor's technology and [becoming] an unexpected competitive threat." Alternatively, "the buyer is exposed to hazards such as the seller asserting that the technology has better performance or cost reducing characteristics than is actually the case, or the seller might render promised transfer assistance in a perfunctory fashion" (Teece, 1982, p. 52). After raising the possibility of bonding or performance guarantees as possible ways to reduce risk, Teece notes that so long as the measurement of the performance of the technology is ambiguous, "costly haggling" might still ensue.

Williamson sees the answer to this vexing problem in what he calls "relational contracting" and one such example bears a strong resemblance to the direct offset structure where a form of bilateral governance emerges under which the autonomy of the parties is maintained (Williamson, 1979, pp. 250-252). Here, independent firms engage in trade—with both parties committed to the maintenance of a friendly and cooperative relationship as a goal of greater value than possible short-term gains available through opportunistic behavior. A carefully designed offset arrangement may also rely upon reputation effects and principal-agent relations to furnish powerful incentives for the provider of technology to ensure a completely successful transfer.

Reputation effects are more likely to be effective in the case of a product which is well known, especially when the seller's product name is familiar. Thus, in the first decade and a half or so of its life, most informed stories in the press referred not to the F-16 but to the "General Dynamics F-16." This helped motivate the General Dynamics Corporation to ensure that transfers of technology to partner states were successfully conducted to minimize the risk of a high accident rate

besmirching the GD name. In the case of the Joint Strike Fighter, Lockheed Martin is similarly vulnerable.[25]

Reputation effects are also an element in many principal-agent cases, in which the challenge is to devise systems which minimize the potential conflict between groups which may not necessarily share the same goals. Such cases may be found in the relations between owners and hired managers, managers and employees, or even physicians and patients. In the last case, one is reminded of the implicit contracts which exist to control the tendency of doctors to prescribe more medical care than their patients might prefer. The preference of surgeons for a surgical option and of radiologists for their specialty is well known. Fortunately, there are a number of factors in the physician-patient relationship which serve to bring the differing interests closer together. Patients are not obliged to accept their doctor's recommendation for treatment, and they may seek a second opinion. In extreme cases, physician behavior may be influenced by the existence of peer review boards, which certainly can influence reputations (Nicholson, 1990, p. 302). In the international trade in defense environment, as well, the challenge for the buyer is to formulate a system which provides an incentive for the seller to seriously accept the buyer's objective as his own.[26]

Such an explanation as to why several offset arrangements appear attractive does not constitute an endorsement of the offset route as the optimal strategy. However, it does suggest why, in many cases, buyers have selected that route to achieve their objectives. Policymakers who, for whatever reason, object to the offset option will likely be more successful if they can suggest alternative (and presumably less onerous) policies to buying states which can better help them to attain their goals. Understanding the objectives of buying states is essential to that recommendation.

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[25] McLeod (2007) offers a comprehensive treatment of reputation effects.

[26] Laffont and Martimort (20020 provide a theoretical treatment of principal-agent relationships.

2. US Offset Data: Collection and Findings

Reporting Requirements: Section 309 of the 1986 amendments to the *Defense Production Act* (*DPA*) dealt with the topic of offsets in defense trade. It mandated that the President submit an annual report to Congress on the impact of offsets on the US defense industrial base. The Office of Management and Budget (OMB) was assigned to coordinate an interagency committee consisting of representatives from the Departments of Commerce, Defense, Labor, Treasury, and the Office of the US Trade Representative. A series of annual reports were prepared and issued by this committee between 1986 and 1990. They included relevant statistics on offsets and valuable case studies of US military aircraft and missile sales to other countries: F-16s to Belgium, the Netherlands, Denmark, Norway, and Greece; Patriot missiles to West Germany and the Netherlands; AWACS aircraft to the UK and France; and F-18s to Canada, Australia, and Spain.

When the *DPA* expired in October 1990, so did the reporting requirement. Several interludes of revival and expiration followed with the *Act* finally revised on October 29, 1992, retroactive to March 1, 1992. While factors other than offsets were apparently more important elements in explaining this strange sequence of actions, the return of the *DPA* also restored the offset-reporting requirement—but with some interesting differences. Henceforth, the Secretary of Commerce was to be responsible for the preparation of the reports and was designated to function as the Executive Agent of the President in administering the requirements of Section 309 of the *DPA*. It should be noted that the Office of Management and Budget was removed from membership in the interagency committee as well as from its former leadership role in the work of the committee. The prevailing opinion at the time saw this change as a reflection of the ire of some Congressional critics at the former committee's reports, which had concluded that the impact of offsets on the US economy and defense technology base were relatively minor. The reports also

provided a fairly sophisticated analysis of proposed Congressional protectionist actions.[27]

Findings: The most recent publication in the series, *Offsets in Defense Trade*, bears the date of December 2007 and contains data current through 2006. This document (pp. iv-v, 2-1 to 2-7, 2-9, 2-11, 2-13, 4-5 to 4-7, 4-9 to 4-10, 5-17) is the source for the data below, unless otherwise indicated. In examining offset data, it is necessary to distinguish between two different concepts: (a) the number and value of new offset agreements between the US defense sector and foreign governments, growing out of a US defense-related export sale; and (b) actual transactions which execute the terms of pre-existing offset agreements.

Twelve prime US defense contractors reported that they entered into 44 new offset agreements with 20 countries in 2006. The number of such agreements and their estimated value were higher than in 2005, the year with the minimum number of agreements over the 1993-2006 period. The 2006 value of such offsets equaled $3.4 billion out of a defense export value base of $4.8 billion, or 70.9%. Some interesting differences emerge when the figures are disaggregated by geographic region. European nations received an average of 85.5% of contract value of defense exports as offsets. The non-European states averaged offset requirements of 42.3%, a significant decline from their 93.2% in 2004.

The December 2007 *Offset Report* presents comparable figures for the 1993-2006 period. Over this 14-year interval, US firms entered into 582 offset agreements with 42 countries, valued at $60.0 billion, or 71.2% of the export contract sales value of $84.3 billion. Aerospace defense system sales accounted for slightly over 4/5 of those total export contracts. During this longer period, European states represented 65.9% of the total value of offset agreements, but this represented only 48.0% of the value of related export contracts. The size of the European offset demands

[27] For a more detailed review of the developments of this period, see Udis and Maskus (1996, pp. 357-379).

averaged 97.7% of export contract values during the 1993-2006 period. Offset agreements valued at 100% or more of contract value accounted for 74.4% of European agreements (by number) during that period. These percentages peaked at 153.3% in 2003. In 2006, the European average increased to 85.5% from 2005's 83.7%. The lowest European average was 63.9% (of export contract value) in 2004.

The offset average for non-European states was 46.7% of contract value over the 1993-2006 period. In general, Middle Eastern and Asian countries demanded lower offset levels than did the Europeans. Of the 269 offset agreements with non-European countries, 68.4% required offset percentages of 50% or less. Only 31.6% demanded percentages greater than 50%, and just 10 of the non-European offset agreements provided for offset requirements of over 100%.

During the 14-year period, Austria led all other countries, with offset percentages equal to 172.2% of the value of defense exports. The next largest five countries and their percentages were Poland (167.7%), the Netherlands (117.3%), South Africa (116.0%), Greece (114.2%), and Sweden (103.9%).

The authors of the Commerce Department report also calculated a moving weighted average to smooth out yearly fluctuations in both defense sales and offsets. The weighted world trend of offset percentage values rose from 49.3% to 102.9% between 1993 and 2005, and then decreased to 76.7% in 2004-2006. During that brief period, the European figure rose from 87.1% to 133.9%, but then fell to 81.2% from 2004 to 2006. The required percentage for the rest of the world increased from 27.6% to 73% over the full 14-year period.

As noted above, another important part of the offset phenomenon consists of transactions initiated to satisfy obligations in furtherance of the terms of earlier offset agreements. US companies reported the total value of such offset transactions in 2006 at $4.7 billion. Indirect offset transactions constituted 63.6% of that figure, while direct offsets amounted to 36.0%.

From 1993-2006, US companies reported a total of 8,660 offset transactions covering 45 countries. The total value of such transactions equaled $42.0 billion—of which indirect offsets accounted for 59.5%, while direct offsets constituted 39.6%. (The tiny unaccounted balance represented offsets of unspecified types.) The majority of offset transactions (77.4%) during this span of time were found in the categories of Purchases, Subcontracts, and Technology Transfers. Their respective shares of the total category were 38.2%, 22.2%, and 16.5%.

With respect to industrial sectors, the majority of offset transactions fell into a small number of major industries involved in defense production. The largest group by far was Transportation Equipment (SIC (Standard Industrial Classification) 37) which accounted for 53.2% of the total value of offset transactions in the 1993-2006 period. Second was the Electronics/Electrical sector (SIC 36), representing only 12.9% of total value.

Longer-term Changes: Over the past thirty-plus years, many changes have occurred in the use of offsets in defense trade. Such variables as the magnitude and value of offset demands, the relative importance of direct versus indirect offsets, the use of brokers to facilitate the indirect variety, the length of the period allowed in which to complete offset requirements, and the methods of enforcement have all shifted.

The comparison period may be lengthened by utilizing data for the bulk of the 1980s and the pre-1980 years from a document in the earlier reporting series assembled under the auspices of the Office of Management and Budget (US OMB, 1990, April 16). The data may not be completely comparable with the later series, but it may still be useful in suggesting broad changes. This document reports “value of implementation” in millions of current dollars. For the pre-1980 years, $312.1 million was recorded, in contrast with $10,786.0 million in the 1980-1987 period (US OMB1990, April 16, p. 137). Data classified as “actual value of transactions” in the December 2007 report of the current series was $42.0 billion for the 1993-2006 period. During the three time periods reported, direct offsets amounted to 26.2%,

30.9%, and 39.6%, while indirect offsets registered 69.9%, 61.4%, and 59.7%, respectively. In any single period, the percentages do not equal 100% due to the inclusion of offsets unspecified by type. It appears that offset demanders' preference for economic activity closely related to the product of the transaction has gradually been realized, while prime contractors' desire to protect the original production layout has been slowly sacrificed.

In the past, brokers often were utilized to assist major defense contractors convert physical quantities of items acquired under indirect offset contracts into cash. Typically, brokers' fees were considered relatively small and saved defense industrial firms from determining how to dispose of items as diverse as hams and tourist trips. Commodity brokers, financial departments of banks, and specialized trading companies were utilized for such tasks.

In more recent years, a new type of broker has appeared—one that specializes in commercializing new technologies developed in university or independent research laboratories. Typically, such organizations are staffed with highly qualified scientists and engineers with little talent for marketing their discoveries. The new generation of brokers, often staffed with technically oriented personnel, concentrates on bringing such developments to the attention of major defense firms with significant technology transfer obligations to foreign governments. Such obligations often focus on environmental and/or health improvements. For a fee, such brokers offer to act as matchmakers, as it were—bringing new and promising technology forward for the principal contractor to offer in furtherance of meeting such responsibilities. At the moment, we are unaware of reliable data to quantify such functions.

Another consideration is the length of the time period over which the offset commitments may be fulfilled. The longer the period, the more difficult it is to attribute subsequent purchases by the prime contractor to the offset requirements. During the 1980-1987 time interval, the average term was 11 years in offset deals entered into by American firms (US OMB, 1990, April 16, p. 136). This period has

been declining as foreign demanders of offsets have become more sophisticated and more exacting. Thus, in the 1993-2006 timeframe, the average period had fallen to just below 7 years (*Offsets in Defense Trade*, December 2007, pp. 4-7). The length of the period appears to have stabilized at this level in more recent years. Other considerations appear to have played a role, particularly the phenomenon of offset credit banking (under which the principal contractor with unexpired offset credits may, as it were, bank them for future use—at least for some specified period of time).

Also of interest is the method of enforcement of offset terms. During the earlier 1980-1987 period, a commitment to "best efforts" was reported in some 68% of cases studied, while the remaining 32% specified "liquidated damages" or some other form of financial penalty for failure to meet contractual obligations (US OMB, 1990, April 16, p. 134). Thus, two thirds of the cases relied upon a figurative handshake to ensure that contract terms would be met. By 1993-1997, a "best efforts" commitment had dropped to about 50%, and while such information is no longer reported in the current annual reports series, an educated guess by a Commerce Department official put the figure at no more than 33%. Thus, it would appear again that offset demanders have become less willing to tolerate an informal and undemanding approach to enforcement of contract terms.

3. A Look Ahead: Offsets or Production Consortia?

Any effort to evaluate the effect of offsets on both receivers and givers must begin by recognizing the complexities inherent in the phenomenon. As noted above, countries demanding offsets differ widely in their goals and in the relative success or failure of their attempts. There has been a shortage of objective and careful work in the area. The attempt to lump together such a diverse group of policies resembles the famous legend of several blind men attempting to describe an elephant after each has performed a physical examination of different parts of the animal.

The foregoing sections have presented several theoretical and real-world considerations, each of which suggests the need for caution before endorsing

wholeheartedly the view of offsets as trade diverting and welfare reducing. A high-ranking executive of a major US aerospace firm recently observed, "Many supplier relationships of today are built on offset relationships of some years ago. We have now learned how to work together without offsets."[28] What is particularly intriguing here is that three decades ago, a Swiss executive described a principal goal of his country's offset policy as designed to bring to the attention of foreign (American) industrialists the high quality of Swiss industry.[29]

This anecdote provides some support for a point made in the conclusions of a paper on offsets published some years ago:

> If their principal effect is to pressure the principal design contractor to broaden its horizons in the search for subcontractors, offsets may actually lead to a more efficient pattern of production linkages and a welfare-enhancing arrangement. Here, an alliance between liberal trade theorists and anti-offset interests may be perverse. (Udis & Maskus, 1991, p. 163)

The authors of the above paper concluded that while some offsets may be efficiency and welfare enhancing, others may contribute to structural inefficiencies in the global economy. Thus, they recommended a serious attempt to identify criteria to differentiate between the two prior to any effort at international control. That need still exists.

4. Beyond Offsets?

Over the years, the heavy attention paid to offsets has tended to veil the fact that offsets, per se, are not a stand-alone phenomenon, but rather represent a stage in the evolving dynamic of international trade in defense items. The post World War II period began with the transfer by the US military of surplus armaments to newly liberated countries. Gradually, this evolved into widespread production under license of American weapons and aircraft with liberal terms to ease the "dollar shortage" of the period. In states with a historic aircraft tradition, indigenous design

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[28] Source is personal interview conducted with a condition of anonymity in 1992.

[29] Anonymous personal interview, Spring 1997.

and production began to appear, followed in the 1970s by a growing use of offset programs.

While little attention has been paid to the principal reasons for success or failure of such programs, it is clear that in many cases, significant technological progress was acquired by the industries of participating buyer states. For example, in a paper which is generally critical of the offset experience of Spanish industry in the F-18 offset program, Molas-Gallart notes that "there were, in fact, cases of Spanish firms building areas of expertise which they would use on new programs and would become part of their technological portfolio." He cites one of the best-known cases as that of the Spanish electronics firm CESELSA in its work on simulators which has contributed to its work in [other] international programs and the development of its own systems (Molas-Gallart, 2006, p. 97). It should also be noted that the Spanish aerospace firm CASA currently is a junior partner in the European aerospace conglomerate EADS, which produces both military aircraft (the European Fighter Aircraft known as Typhoon) and civilian passenger aircraft (the Airbus family). Some years ago in private interviews, Spanish government officials expressed such developments as goals of CASA's participation in the F-18 Hornet program.

In fact, the evolution of Spanish offset policy provides a microcosmic example of what may be happening more generally in the offset arena.[30] When the Spanish offset agreement was negotiated in the early 1980s, indirect offsets were much more important than the direct variety. This resulted in a large number of companies involved in generally small offset activities. A significant effort was required to administer these operations, as McDonnell Douglas submitted these projects for approval individually and each had to be approved by the Spanish Offset Management Office. Soon, the Office was inundated with paperwork. During the ten-year program, thousands of projects and project applications were processed.

[30] The details following for the Spanish F-18 offset program and its impact on the evolution of Spain's offset policy are drawn from Mollas-Gallart (1996).

The relatively small share of defense-related offsets (28% of total program value) was a disappointment, as was the even smaller share representing technology transfer.

Following the expiration of the formal contract period, a three-year “grace period” was negotiated; this contained substantial changes reflecting the experiences of the first decade. In retrospect, from the Spanish perspective, the original program was structured in a way that generated high overhead and transaction costs due to an excessive number of projects with inadequate strategic focus. The emphasis shifted dramatically from indirect to direct offsets closely associated with the F-18 aircraft. The nature of these offsets had to be agreed upon in advance, so that the Spanish were no longer simply reacting to suggestions initiated by McDonnell Douglas.

In the early years of the program, Spanish industry had only a limited capability to handle direct work on the aircraft. The Spanish defense industry was fragmented, technologically weak, and largely state-owned. The principal actors were each associated with one of the three armed forces: CASA (Construcciones Aeronáuticas, S. A.); BAZAN for the Navy; and ENSB (Empresa Nacional Santa Bárbara), which produced land armaments for the Army. To correct this situation, the Spanish Government began to incorporate local industry into defense research activities. From the mid-1980s to 1991, government support of defense R&D had climbed from insignificant levels to nearly 30% of total Spanish government R&D outlays.

These efforts had repercussions beyond the F-18 program and served to bring the capability of the Spanish industrial base closer to the level of its neighbors. Spain became a player in various European collaborative arms design and production programs—including the European Fighter Aircraft (Typhoon) project, which by the early 1990s was absorbing more than 3/5 of total Spanish defense R&D. It should be noted that the companies receiving the bulk of this investment were largely those that had been most involved in the F-18 direct offset activities.

Thus, Spanish defense acquisition programs had shifted from classical offsets to multinational collaboration, which gave the Spanish partner a voice in system configuration. An interesting example is provided by Spain's purchase of eight Harriers and updating of twelve AV-8B Harriers in the early 1990s. The work of developing a new Harrier variant was organized as a joint program with the US, Italy and UK. Though a step up from the role of "buyer with offsets," there was some concern that Spain might find itself a junior partner providing unsophisticated parts for a larger, integrated European defense market.

It was hoped that the Spanish defense industrial base could be strengthened through a program of foreign direct investment. This would not be completely new, as US and French firms had acquired minority holdings in state-owned defense companies during the late 1960s and early 1970s. However, these activities were usually tied to specific procurements—which, at their conclusion and in the absence of follow-up orders, tended to wither away.

There was particular concern for the major Spanish prime contractors (CASA, ENSB, and BAZAN, now known as IZAR). What was sought was an ongoing partnership with established foreign firms which would ease Spanish producers into an international supply chain. A series of deals with foreign firms eventually saw CASA enter the new European consortium EADS.

After a series of efforts to attract foreign direct investment into ENSB, in an unexpected move, the company was sold to General Dynamics of the US in the spring of 2000. Although Kraus-Maffei (KM) of Germany had been successful in selling its Leopard tanks to Spain (which were being produced in ENSB facilities), General Dynamics (GD), a major competitor of KM, now owned ENSB. This required the establishment of a "Chinese Wall" to protect the confidentiality of KM technology and to prevent it from falling into the hands of its major competitor, GD.[31]

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[31] This may well be a difficult task, similar to that faced by Lockheed Martin in producing two new USAF fighters, the F-22 and F-35, with a different set of partners involved in each project.

The Spanish Government will also have to determine what its role will be in providing a continuous stream of orders necessary to retain the interest of its foreign partners.

5. Offsets vs. Industrial Participation

The wording of this subsection title suggests that the structure of the F-35 JSF program may point the direction of future international collaboration. Respected defense economists have examined the question and given somewhat varying answers. Its theoretical emphasis on work assignment based on quality rather than politically attractive work-share schemes has naturally appealed to those trained to economize in the use of scarce resources and who view waste as close to sinful.

Two British economists have examined the issue. Keith Hartley sees the JSF as providing a model for future multinational collaboration, which would be desirable if it can be attained (Hartley, 2004, pp. 133-134). Ron Matthews identifies offset policies which might enhance technological development but doubts their likelihood of adoption. He concludes, "This is an ambitious agenda, and hanging on the presumption that offsets are here to stay. History has shown this is not to be the case" (Matthews, 2004, p. 100). This would appear to be a rather unequivocal prediction of the demise of offsets. In a later paper, Matthews describes collaborative projects (like the Typhoon) and consortia ventures (like the JSF) as demonstrating "the twin attraction of member countries enjoying [lower] R&D costs and higher economies of scale from the unification of markets. The lowest cost-acquisition option is arguably the global consortia model." (Matthews, 2006, pp. 82-83) He goes on to note:

> However, although this model carries the benefits of a more refined international division of labour, including lower cost and enhanced product quality, the downside is the erosion of defence-industrial sovereignty caused by increased dependence on offshore vendors. The question, however, is whether this loss of defence-industrial sovereignty any longer matters? Further (transformational) warfare is expected to be a quick and decisive exercise. It will incorporate a coalition doctrinal approach, justifying further cooperation in the development of weapons systems as self-reliance becomes less and less an affordable option. (Matthews, 2006, also pp. 82-83)

Matthews' perceptive paper also recognizes that the "global consortia model, requiring that workshare be based on the competitiveness of member countries' national industries" has meant that the majority of work has been captured by highly efficient US and UK defence contractors, leaving minimal work for smaller country participants" (p. 86). Only time will tell whether this will be an accurate picture of, say, the JSF program. However, it appears to support an earlier designation of the modern international defense marketplace as resembling a "hub and spoke" model in which:

> A few large first-tier firms operating at the centre with lines of outsourced production extending out to second-tier states on the periphery. First-tier players would serve as "centres of excellence," providing armaments production with its critical design, development, and systems-integration inputs, along with the production of more advanced subsystems, such as engines, wings, sensors, information systems, and other electronics. Second-tier arms producers would mainly be responsible for supplying niche systems or low-tech items, such as structural components. Final assembly could take place in either country, depending on the end-user. Such cooperative arrangements could be highly formalised, involving a second-tier firm working for only one first-tier producer, presumably as a wholly- or partially-owned subsidiary. It is, however, likely that this process would entail second-tier enterprises being engaged in subcontracts or joint venture partnerships with several first-tier firms at the same time. As such, future armaments production could more closely resemble the modern concept of the "virtual corporation"—independent firms coming together on an as-needed basis in order to design and/or develop and/or manufacture a product, only on a global scale. (Bitzinger, 2003, pp. 74-75)

C. Transaction Cost Economics

Transaction Cost Economics (TCE), as a branch of economics, arose as part of the systematic study of firm "boundaries." More specifically, Coase's seminal article specifically posed the question as to why firms make products (or components) within their enterprise boundaries instead of purchasing them (seemingly more cheaply) from other businesses who specialize in making those products (Coase, 1937). The basic insights from Coase's (and succeeding inquiries) are (a) that the market itself is not a frictionless, costless medium, and (b) that choosing to buy rather than make some item may well involve forming a relationship rather than simply making a purchase (Franck and Melese, 2005). Research along

these lines has also revealed that managing such relationships is, likewise, not costless.

The TCE School holds that a careful analysis of alternatives (make vs. buy) would consider more than just the production costs. Choosing, for example, to produce “widgets” within the the firm involves management time and attention to ensure that widgets are produced efficiently, and in ways that effectively support the rest of the firm. These are generally called “agency” costs (Besanko, et. al., 2000).

Likewise, buying the widgets from a firm that specializes in producing widgets involves the (transaction) costs of operating in the marketplace and managing any business-to-business relationships formed. Thus, in general, firms should buy the widgets, or “outsource” them according to a fundamental rule. If

(Internal Production + Agency) Costs **>** (Outsourced Production + Transaction) Costs,

then widgets should be purchased from some other firm and not produced in-house (Frank & Melese, 2005; Franck, 2004).

There is good reason to believe that for many types of widgets, internal production costs exceed outsourced production costs. Firms that specialize in widget production and sell those widgets to make a profit are highly motivated to produce as efficiently as possible (i.e., producing today’s widget orders at least cost). Furthermore, in a competitive market, those firms are also motivated to find ways of reducing the cost of their widget production—to gain a competitive advantage over rivals that leads to profits. Moreover, in a competitive market, the results of such innovations are eventually passed to buyers in the form of lower prices (Franck, 2004). Furthermore, widget-specializing firms in competitive markets tend toward full exploitation of economies of scale. Since they produce widgets pretty much continuously, they can also take full advantage of economies available from extended serial production (learning by doing) (Besanko, et. al., 2000; Franck, 2004).

Hence, there is an apparently strong case for outsourcing. And in many cases, it's compelling. For example, paper clips are readily available in local markets. Their purchase involves a one-time exchange (or a series of one-time exchanges); there is no need to form a relationship with another firm. Hence, the transaction cost associated with paper clips is very low, relative to the cost of making needed paper clips in-house. And, as one would expect, few (if any) commercial enterprises make paper clips just for their own use.

There are also cases in which the decision to outsource involves some sort of relationship with another firm. In order to fully achieve the benefits of outsourcing, it might well be necessary for the two firms to alter their portfolio of assets in order to fully realize the benefits of their relationship. That is, the outsourcing relationship may well create a significant, and shared, benefit based on continued partnership. In such cases, the outsourcing relationship changes significantly—from the widget-making firm being simply the winning bidder to becoming a close partner with its buyer. The TCE literature calls this the *fundamental transformation*; the relationship with one's widget supplier changes from being a one-time, arms'-length market exchange to a fully involved partnership (Besanko, et. al, 2000).

The danger for both firms is that either party, or both, may choose to dispute the division of the shared benefit. Tactics for doing that fall, in general, to the category of "opportunistic behavior" (Williams, 1996). The quest for larger shares may also involve a "holdup," a threat to dissolve the (mutually beneficial) relationship without a significant renegotiation of its terms (to the advantage of one partner and at the expense of the other) (Besanko, et. al., 2000).

Firms entering into such partnerships are, of course, aware of such dangers and can take measures to prevent or mitigate them. One obvious measure to prevent bad behavior on the part of one's partners is to insist on a well-structured contract—which should prevent expected problems and provide a governance mechanism to deal with unexpected problems (Besanko, et al., 2000; Franck, 2004). However, it's impossible to adequately deal with all future contingencies (just as it's

impossible to fully predict the future); this is called “bounded rationality” in the TCE literature (Williamson, 1996). Other measures include well-chosen schemes of asset ownership and maintenance of a standby widget production capability in-house. Such provisions are said to fall into the category of “tapered integration” (Franck and Melese, 2005).

The problem, of course, is that the measures discussed above (and others) all come at a cost. Writing, negotiating, renegotiating and enforcing contracts can involve significant costs. Likewise, tapered integration involves second-best production arrangements that impose costs by their inefficiencies. Thus, transaction costs may well overwhelm the production cost savings, plus the management (agency) costs associated with in-house production.

TCE research has identified a number of indicators of expected transaction costs in outsourcing relationships. Prominent on that list are the following:

- Asset Specificity,
- Complexity of Project,
- Length of Relationship,
- Frequency of Orders,
- Time Sensitivity, and
- Operational Significance. (Powell, 2002; Franck, 1994, pp. 38-39)

As indicated above, Asset Specificity involves making investments in the outsourcing relationship, when the value of the assets acquired is much less in other contexts. Complex outsourcing relationships are more likely to have only a few qualified suppliers available (perhaps only one); this, of course, limits competition—the buyer’s main source of leverage. Long-term relationships entail long-term planning and probably long-term contractual arrangements. With the longer time horizon comes greater difficulty in foreseeing potential problems and (especially) opportunities for opportunistic behavior. Frequency of orders for goods and services may well convey efficiencies from learning by doing for the incumbent contractor.

This, in turn, means a significant disadvantage for potential competitors—strengthening the incumbent's position and providing added scope for opportunistic behavior or a holdup. Finally, some outsourced goods and services involve severe consequences if not delivered (or performed) in a timely manner. That is, the frequency of crisis situations with a high degree of operational significance and time sensitivity increases the supplier's bargaining position and, accordingly, increases scope for opportunistic behavior. And, of course, increased scope for opportunistic behavior on the part of the supplier increases the buyer's risk.

A thesis at the Naval Postgraduate School (NPS) by Powell (2002) offers a simple method to assess these risks—through a stoplight scheme. If, for example, the outsourcing relationship involves a high degree of asset specificity, then there is increased risk for the buyer (and for the seller as well). This aspect of the program would rate a "red light" assessment—identifying an area for risk reduction efforts (to include producing in-house).

1. TCE Considerations for National Military Establishments

As indicated above, nations, for good reason, regard defense production capability as a matter that is closely related to national sovereignty. It's reasonable, therefore, to regard the nation and its defense industries as being merged for purposes of national policy.

In that context, the decision to purchase arms from abroad is a political analog to the decision of commercial businesses to outsource production of goods or services. While outsourcing can be quite attractive in terms of production cost, there are the risks associated with opportunistic behavior on the part of suppliers.

The rise of the nation state in the Seventeenth Century has been closely linked to a "military revolution" associated with the Artillery and Fortress RMAs (Krepinevich, 1994). One of the principal outcomes of the revolution was greatly increased costs of waging war—both offensively and defensively. Accordingly, the rise of European great powers was, in significant part, an attempt to realize economies of scale in military affairs (Parker, 1989; Rogers, 1989; Krepinevich,

1994). That is, one of the principal reasons for nation-states is their usefulness as military enterprises—both as forces and as means of production. Thus, the rise of the nations was (in a very real sense) a merger and acquisition campaign to achieve effective vertical integration of the warfighting enterprise.

The contemporary tension is that nations are no longer well-integrated military enterprises. A number of trends—including globalization and the changing nature of economics of scale in military production (discussed above)—have put this aspect of sovereignty under considerable strain.[32]

Because states are no longer fully integrated (autonomous) defense production enterprises, the issue of relationships with supplier nations has become: (a) an increasingly important security policy issue, and (b) a source of tension in the global defense marketplace. This perspective will be treated in greater detail when considering the UK's Defence Industrial Strategy below (UK Ministry of Defence, 2005).

D. Corporate Strategy Models

Two standard models of corporate strategy come from Porter (1980), and Brandenberger and Nalebuff (1996).[33] Porter's model is called "Five Forces;" Brandenberger's is "co-opetition." A graphical representation of the Five Forces model appears in Figure 1 below. The basic picture is one of a (presumably profitable) firm besieged by a number of actors who wish to take away some (or all) of those profits. They are categorized as current industry rivals, potential entrants (aspiring rivals), buyers (or customers), suppliers, and firms in related industries. The Five Forces Model is offered as a means of better understanding that firm's situation.

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[32] If we take this line of thought to a natural (if extreme) conclusion, we can observe the irony of states becoming smaller on average over the past half century, while the size of state needed to achieve economics of scale in military production has increased greatly.

[33] Also, these sorts of analyses are a standard part of managerial economics. An excellent discussion of corporate strategy is found, for example, in Part Three of Besanko et al., 2000.

In Porter's scheme, the threat from *current rivals* is most acute with a (a) large number of sellers in a (b) declining market in which (c) firms have overcapacity but face (d) exit barriers. Barriers to entry protect against aspiring competitors (*potential entrants*). They typically exist in the form of: (a) economies of scale, (b) brand loyalties, (c) access to inputs, technology and local knowledge, and (d) government protection of incumbents.

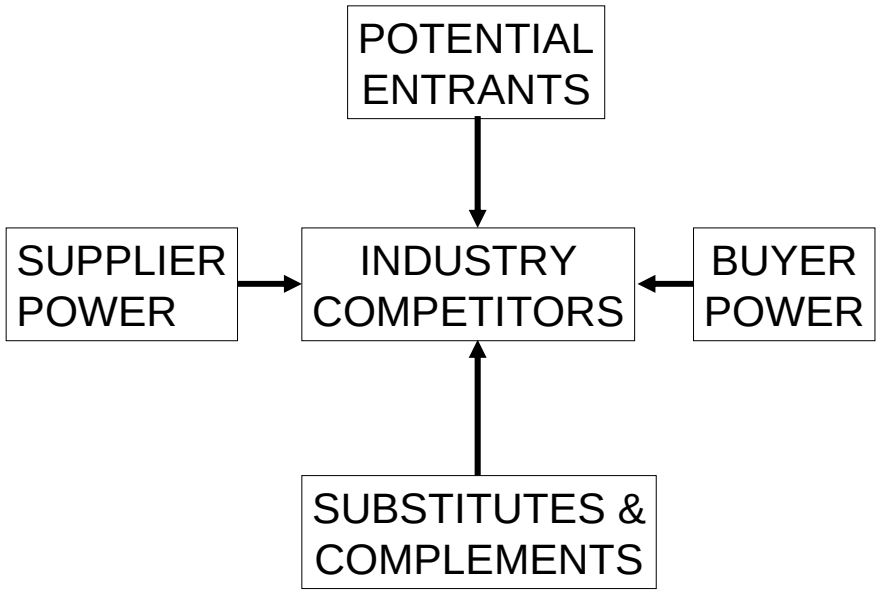

Figure 1. Porter's Five Forces Model
(Porter, 1980, p. 4; Besanko, et. al, 2000, p. 361)

The availability and closeness of substitutes and complements also affects firm profits. For example, improvement in quality or lower price of a close substitute could induce the firm's customers to switch to the alternative product and significantly lower its profits.[34] Likewise, an improvement in quality or lower price of

[34] Thus, for example, we would expect Coca Cola to pay careful attention to (say) fruit juices (substitutes) on the market, as well as Pepsi Cola (an industry competitor in Porter's scheme).

a complement could induce customers to buy more of that complement and, with it, more of our firm's product—thus increasing profits.[35] Suppliers (including unions) with considerable market power could substantially increase prices of inputs, and lower profits. Similarly, buyers with significant market power can drive hard bargains for their supplying firms. (Sovereign entities, like governments buying defense equipment, have—by definition—considerable power in dealing with defense industrial firms.)

Within Porter's Five Forces scheme, there are three basic strategies to mitigate or avoid threats to profits. First is to develop cost or performance advantages (or both). The second strategy is to find and enter a new market niche in which there are less severe threats. The third is changing the Five Forces to decrease the threats.

The "Co-opetition," or Value Net, approach is not really a competing theory to the Five Forces. It is best regarded as a shift in emphasis from the Five Forces framework. Fundamentally, Brandenberger and Nalebuff (1996) offer a view of a business environment that emphasizes opportunities as well as threats. The basic "Value Net" perspective is depicted in Figure 2.

The Value Net (or Co-opetition) view emphasizes opportunities as well as threats. The basic idea, among others, is that firms can find opportunities as well as threats. There are potential allies as well as competitors to be found in the environment. While some products pose a threat to profits (as substitutes), others offer opportunities for profits (as complements).

[35] However, Porter's perspective is much more involved with threats to profits than with profit improvers. Porter's version of Figure 1 does not include "complements" in its basic diagram; however, Besanko's rendering of the Five Forces does.

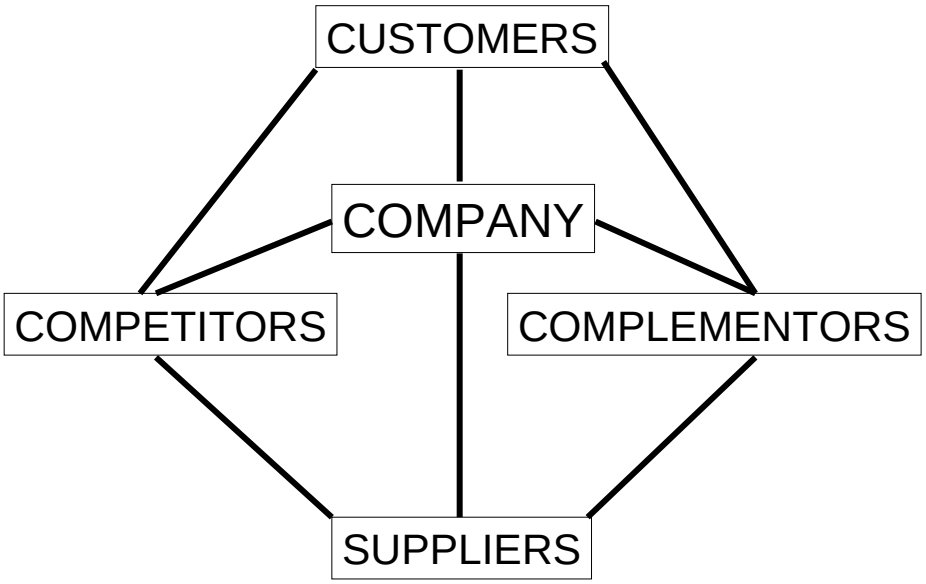

Figure 2. The Co-opetition Model (Value Net)
(Brandenburger & Nalebuff, 1996, p. 17)

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IV. Three "Cases": Joint Strike Fighter, UK Defence Industrial Strategy, and KC-30 Proposal

We have chosen to exercise our models and assess their usefulness in explaining three ongoing (and interesting) cases, which feature extensive involvement of both governments and major defense industrial firms on both sides of the North Atlantic. For each case, we provide first an interpretative narrative of relevant events. We then offer explanations for the observed events using the models developed in Section III above. Our cases are the Joint Strike Fighter (A), the UK Defence Industrial Strategy (B), and the KC-30 proposal from EADS and Northrop-Grumman (C).

A. The F-35 Joint Strike Fighter (Lightning II)

The F-35 Joint Strike Fighter is intended not only for operation by multiple military services, but also by many partner nations. This case is interesting for a number of reasons, including its antecedents and history, project organization, and the responses by the many national and corporate participants. It's also interesting because of its potential effects on defense industries worldwide.

1. History[36]

The roots of the F-35 can be traced to efforts underway in the late 1980s and early 1990s by the US Navy, Marine Corps, and Air Force to develop a next-generation strike aircraft. The US Navy's work on the stealth A-12 Avenger II was cancelled in 1991 in favor of a successor project (A/F-X) to develop a new Fighter/Attack aircraft. Concurrently, the US Air Force was seeking a next-generation strike aircraft to replace the F-16, which was designated the Multi-Role Fighter (MRF). Likewise, the US Marine Corps was also searching for a modern Short Takeoff and Vertical Landing (STOVL) aircraft to replace its AV-8B Harrier II.

[36] Goebel, 2006.

As it turned out, the British Royal Navy was thinking along the same lines as it considered retiring its Sea Harrier naval fighter aircraft. The two allied services joined their efforts and collaborated in the late 1980s on STOVL research. The US Defense Advanced Research Projects Agency (DARPA) also initiated a series of studies of various STOVL concepts. As the US Marine Corps expanded its goal to also replace its conventional F/A-18 Hornet aircraft, DARPA's efforts yielded the concept of an advanced STOVL fighter capable of conventional takeoff and landing. It was identified as the Common Affordable Lightweight Fighter or "CALF."

In September 1993, the Clinton Administration cancelled both the Navy A/F-X and the Air Force MRF projects. However, the DoD was permitted to establish a research office to study what was called Joint Advanced Strike Technologies (JAST) for future development. Shortly thereafter, the Congress required that DARPA's CALF research be merged with the JAST office. Rapid progress followed toward building a next-generation strike fighter.

The jointness goal was to be met by the development of three different variants of an aircraft with a common technological base. Three versions of the aircraft were needed to meet a trinity of requirements: The USAF desired a conventional attack aircraft with stealth, advanced avionics, and low life cycle operating costs which could deliver reliability, good range, speed, and significant weapons load.

The US Navy's operational needs were similar, but to meet the demands of carrier operations, its carrier version (CV) required larger, folding wings for low-speed carrier approaches and sturdier landing gear, plus an arresting hook to accommodate carrier landings. The US Marines and British Royal Navy desired a capable attack aircraft with advanced STOVL qualities to permit operations from forward battlefields, and smaller helicopter carriers and British "jump jet" operations off of carriers. All variants were required to be capable of defending themselves and to provide protection of fleet assets against attack. Performance had to be at least comparable or superior to existing aircraft. Such varied capabilities were to emerge

from a conventional baseline aircraft, the F-35A (Conventional Takeoff and Landing or CTOL) priced at the USAF requirement, with incrementally higher prices to meet the carrier, the F-35C (CV), and the F-35B (STOVL) versions.

The JAST program office released a request for proposals in March 1996. Shortly thereafter, the project name was changed to Joint Strike Fighter. Three groups responded to the request: a McDonnell-Douglas-headed team joined by Northrop Grumman and British Aerospace (later absorbed into BAE Systems), a Boeing team, and a Lockheed Martin team. Later in 1996, the concepts submitted by Lockheed Martin and Boeing were chosen as finalists, and both firms started work on a demonstration aircraft. In October 2001, the X-35 of Lockheed Martin was declared the winning entry. Apparently the race was close, but Lockheed Martin's design was viewed as the less risky alternative. In addition, its lift-fan design for the STOVL model was judged most promising. It also resembled a single-engine version of Lockheed Martin's F-22 Raptor, contoured for stealth. (Details of the competing models are available from Goebel, 2006, pp. 3-5).

Advanced weapons concepts and affordability were guiding principles in JSF design. All F-35 models share in common an integrated core processor that joins data from all the aircraft's sensors into a coordinated view of the battlefield. Its sensors include an active, electronically scanned array (AESA) radar with a synthetic aperture radar mapping mode to yield a precise search and targeting capability superior to any now found in US attack fighters. Although not optimized for air-to-air combat, the JSF’s equipment includes an infrared search and track (IRST) system which would be useful in that mode. Its air-to-ground attack features include an electro-optical targeting system (EOTS) with a forward-looking infrared imager (FLIR), a targeting laser, a laser spot tracker, and a CCD TV camera. JSF software can analyze the information provided by these sensors using an automatic target recognition and classification (ATRC) system to identify specific targets. A speech recognition system obviates the need for the pilot to manually operate certain switches and buttons.

Despite such advances, a concern for limiting costs can be traced to other features of the aircraft. Stealth was one area where design was not pushed to a limit to achieve maximum advantage. Thus, while the JSF design used internal weapon bays and shaping contours to help reduce the aircraft's radar signature, it has not attained the stealth level of such existing aircraft as the F-22 or B-2. Large munitions loads will have to utilize underwing storage pylons to supplement the capacity of the internal weapon bays—a further sacrifice of stealth.

Jointness: The term "joint" in Joint Strike Fighter indicated that it was seen as a military platform which could meet important needs on a multiservice level (“General Dynamics F-111,” 2008). Skeptics could point to the failure of the prior effort designed to meet joint service needs in the 1960s, the F-111 pressed by then Secretary of Defense Robert McNamara. However, advocates of the JSF saw it as much more likely to successfully meet such needs and to avoid the pitfalls which frustrated the prior effort. A comparison of these two projects might prove helpful in weighing the JSF's prospects for success.

The origins of the F-111 are found in the TFX program of the early 1960s, which sought to combine the Air Force requirement for a fighter bomber with deep strike interdiction capabilities, with the Navy’s need for a long-range carrier defense aircraft to replace the F-4 Phantom II and the F-8 Crusader. The Air Force objective was to acquire a fast strike aircraft with the capability to approach a target at low altitude in order to deliver its weapons (including nuclear). Air-to-air combat would be a very low priority for such an aircraft. The Navy's needs were quite different. It was seeking a long-range, tough interceptor to defend carrier task forces against enemy bombers armed with anti-ship missiles.

Size and weight constraints imposed by carrier landing requirements posed a difficult problem for the design of a fleet air defense aircraft with superior loitering performance and load-carrying capacity. Mutual inconsistencies were found to exist between airframes optimized for very high speed (with consequent high fuel requirements, lower range and payload, and high landing speeds) and those

optimized for greater fuel efficiency (with heavy load capability over longer range with reduced combat performance).

Designers saw variable geometry (swept wing design) as a possible route to an acceptable compromise. The Navy was highly skeptical of this solution. It had already tried variable geometry in its XF-6F Jaguar, which it subsequently abandoned in 1953. The variable geometry technology available in the early 1960s seemed to bring significant problems—for example, higher cost and additional weight associated with the swing wing equipment, and limited ordnance carrying capacity imposed by the swept wing design.

While designers attempted to meet the Navy's unique needs in the F-111B model, the solutions attempted were unsuccessful. The case for the F-111B deteriorated during the Vietnam War when air combat indicated that the Navy still required a fighter with close-range air-to-air capability superior to the F-4 Phantom II then in use. If anything, the F-111B appeared inferior to the F-4 for medium-altitude combat. By late 1967, the Navy recommended the cancellation of the F-111B program, which occurred the following year.

Interestingly, the entire effort was not a complete waste of resources as the F-111B's variable geometry design, TF-30 engines, Phoenix missiles, and radar were successfully utilized on its successor, the F-14 Tomcat. The F-111 saw service in the US Air Force from 1967 through 1998, and entered service with the Royal Australian Air Force in 1973, where it has only recently been retired from operational service.

While conceived as a multi-role fighter, the F-111 spent most of its operational life as a long-range attack aircraft, essentially armed with air-to-surface weaponry. What logic suggests that the JSF will not suffer a similar fate? One answer may be found in three developments: technical, operational, and bureaucratic. There have been important technological advances since the early experience with the F-111. Perhaps the most important was advances in composite

materials that dramatically reduce aircraft weight. Other developments include advances in aircraft engines, miniaturization, avionics, computers and weaponry.

Also, several major firms working on the F-35 have also been involved in the development and production of the F-22, a top-of the-line air superiority fighter now entering service in the US Air Force. There have apparently been several cases in which familiarity with the F-22 experience has benefited the F-35 project (Butler & Phillips, 2007, September 17, pp. 34-45).

On the operational front, the US armed forces have greatly expanded their experience with and understanding of joint military operations. The importance of such operations has filtered down into the programs of the major service academies and mid-career training. Joint command experience now is required among officers aspiring to promotion to the higher ranks.

Finally, the top levels of the DoD have indicated a lack of patience with knee-jerk negative reactions to efforts to obtain economies resulting from unified approaches to military challenges. The cancellations in 1993 of both the Navy's A/F-X and the Air Force's MRF projects by the Clinton Administration, noted above, have not been forgotten. Not surprisingly, the major problems encountered thus far in the JSF project have occurred in the F-35B, the STOVL version. Early F-35B designs suffered from excessive weight. The final solution to that problem required a smaller internal weapons bay than that found in other F-35 models, with a consequent substantial reduction in the weight of weapons carried. Further weight reduction was attained by shortening the vertical tails with attendant uncertainties. The resolution of other such problems will give a strong clue to the future success of the program.

Organization: From early in the life of the project, the Office of the Secretary of Defense (OSD) issued guidance that stressed that the program be designed to include international participation. Given the longstanding interest in and prior experience with STOVL in the several Harrier models, it was a foregone conclusion that the UK would play a major role in the JSF project. Other international partners in the Concept Demonstration Phase were Denmark, the Netherlands, Norway,

Canada and Italy. Australia and Turkey joined the JSF team somewhat later as Level III partners in the current Systems Development and Demonstration (SDD) Phase, which is expected to continue until 2012-2013 when the final Production, Sustainment and Follow-on Phase is initiated.[37]

To fully understand the organization of the JSF project, it is necessary to distinguish between the Government-to-Government level at which the basic nature of each partner's participation is specified, and the industrial side of the project which deals with production. The governmental stage deals with the size of the country's financial contribution to the project (its investment), its degree of participation in the Joint Program Office, in aircraft design, and in broad overall operational details (such as logistics) to insure an efficient worldwide availability of spare parts and other requirements for sustainability of the fleet.

Although a commitment to purchase aircraft was not formally required of the partners, the possibility of such sales certainly was an attractive prospect from the viewpoint of extending the length of the production run and enjoying the benefits of volume economies. Standardization and interoperability in the air fleets of friendly and allied states offered the opportunity for efficiency in maintenance and logistics.[38]

Potential market size for the JSF was seen to be substantial, approaching 3000 aircraft—even without including possible third-country sales. Early estimates included 1763 CTOL variants for the USAF, replacing F-16s and A-10s. The US

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[37] The bulk of the material presented in this section applies to the current SDD Phase, and much of it comes from Schreiber (2002, November, p. 164).

[38] A caveat is necessary here on the potential benefits of commonality. Such commonality in design of aircraft of member countries will have to operate within the constraints imposed by the US National Disclosure Policy. This potential problem was recognized early, and in mid-1999, the plans for proceeding in the SDD phase were approved by the DoD's Arms Transfer Policy Review Group. This strategy was then coordinated with and approved by the Department of State. In an effort to recruit the support of the Legislative Branch, key staff members of the House and Senate Foreign Relations Committees were also briefed before the SDD strategy was implemented. It would appear that the managers of the program have taken steps to anticipate and deal with this issue. However, some Lockheed Martin executives still feel that the effectiveness of these actions will only be determined with the passage of time as specific cases arise for resolution.

Marine Corps could absorb 609 STOVL models, replacing F/A-18 C/D Hornets and AV-8B Harrier IIs, while the Navy was contemplating 480 CV variants to replace FA-18C/D Hornets. The British Royal Navy and Air Force were considering a total of 150 STOVL models to replace Harrier GR.7/9s. (It should be noted, however, that more recent estimates of these figures show a reduction of approximately 500 aircraft.) Partner purchases are seen as approaching 600. Project lifetime sales projections exceed 5000 aircraft.

In the current System Development and Demonstration (SDD) Phase, three levels of participation were established for partner countries: Level 1 (full partner)—Only the UK qualifies for this level with a contribution of $2 billion; Level II (associate partner)—Italy and the Netherlands; Level III (informed partner)—Australia, Canada, Denmark, Norway, and Turkey. There also is an arrangement for other countries interested in acquiring JSF aircraft under FMS purchase programs to enter as Security Cooperation Participants. Thus far, Israel and Singapore have joined under such terms.[39] The number of national military officers which each member country may contribute to the integrated program office staff is keyed to the size of the nation's financial contribution. Currently, there are a total of 42 non-US officers serving in the Crystal City Joint Program Office. Participation in the various Integrated Product Teams within the Program Office is expected to offer a greater role for influencing and understanding the development process.

Calculation of participants' return on investment also reflects their level of investment. Normally, a non-recurring R&D cost recoupment charge is levied on the purchase price for buyers of US military equipment. This charge will be waived for Level I and II partners. Level III partners will be able to credit the amount of their investment toward the applicable non-recurring R&D recoupment charge, while the balance may be waived on a case-by-case basis. Partners will also share third-party

[39] Both of these countries maintain small project offices in the Washington area. Israel is now initiating JSF-contracted studies to better understand how a JSF aircraft can be modified to accommodate Israeli-designed C4I equipment, weaponry, and electronic warfare devices (Opall-Rome, 2007, October 29, p. 1).

levies on JSF aircraft built for FMS buyers. This share will also be proportional to partners' SDD investment.

Such organizational arrangements bear an unmistakable similarity to the "pay to play" model increasingly found in commercial business transactions. In the commercial form, the quid pro quo for an investment by suppliers in a project is usually a guaranteed order and a share of the profit earned on the product sold.[40]

However, once attention shifts to the production side of the JSF project, this resemblance disappears. Participation in the work of the program office is linked to the amount of the investment, as is waiver of recoupment of non-recurring costs and sharing in such costs paid by FMS purchasers. However, participation in production is to be determined entirely by selection of the best supplier available. Participation in the project assures partners of first opportunity to bid for work in the production phase, but there is no such thing as "guaranteed work share" related to investment. Attractiveness of the bids offered by partner industry is to be determined by the principal contractor and/or major subcontractors—in this case, Lockheed Martin, BAE, and Northrop Grumman on the airframe, and two engine consortia: one headed by Pratt and Whitney (P&W), and the other by General Electric (GE) and Rolls-Royce (RR).

Offsets and the Joint Strike Fighter: The JSF program was designed to avoid offsets in the relations between the US and the eight partner states. Theoretically, the partners have agreed that selection of participating producers in their countries would be the responsibility of the overall prime contractor, Lockheed Martin. In reality, there may be some room for negotiating whether this could be interpreted to mean that Lockheed would have the final word in choosing from a list provided by the partner state. Lockheed has already complained that particular partners have urged the Joint Program Office to apply pressure for a favorable decision from

[40] For a description of pay-to-play in commercial aerospace, see Lunsford (2007, p. A-1). In effect, Boeing converted major suppliers into risk-sharing partners.

Lockheed. In any event, this issue is likely to remain a continuing problem and a subject for ongoing negotiation. The heart of the problem is found in the expectation that participation in the F-35 supply chain will be restricted to firms that have a reputation for efficient work. As Markowski and Hall have noted, "… There appears to be little scope for pump priming new or untested suppliers (in the project)" (Markowski and Hall, 2006, p. 19).

Another likely source of difficulty looms in the future as non-member countries appear to negotiate purchases of the JSF under terms of the FMS program. There is a high probability that they will demand direct offset work on their aircraft and the terms of such purchases will be negotiated by the US Department of Defense, not the Joint Program Office. The potential award of such offsets clearly will not be welcomed by the original partner states that paid an initiation fee, as it were, to join the program. Such a circumstance could also result in the replacement of efficient subcontractors in the supply chain by less efficient producers in the new buying state. The possible waiver of the usual R&D recoupment charge to encourage such sales would also come at the expense of the partner states that were to share in such fees as a benefit of membership.

All things considered, multinational consortia such as the JSF project are not likely to effect a clean break from offsets. As Molas-Gallart has observed,

> This is not to say that offsets are a thing of the past. Although their relative importance is diminishing, Spain has accumulated important experience in negotiating and managing offset agreements. Because the Spanish administration feels it is learning to extract better offsets then before, the offset option will remain an alternative to consider in almost any weapons transaction. Yet with the preference given to other forms of "compensation" like international cooperation, or direct foreign investment in Spanish defence production, offsets will probably be increasingly limited to small transactions…In other words, offsets are here to stay as one element of the Spanish arms purchasing policy. (Molas-Gallart, p. 317.]

Spain is unlikely to be the only country to adopt such a policy.

2. Partner Reactions

Detailed interviews were conducted with officials of each of the partner states in late September and early October 2007. These meetings were held with a guarantee of confidentiality and non-attribution. All agreed that frank exchange of opinions would be to the advantage of all parties associated with the JSF project, and it is in that spirit that the following is presented. These perspectives are presented below by country (in alphabetical order).

Australia: A source of complaint for Australia was the perception that Lockheed Martin and BAE treat anything produced abroad as an example of an offset. The Australians resent this as they “pay up front for anything they get.” They feel that their talents and contributions are underappreciated. It was pointed out that they have contributed to over 100 systems used by the US Navy and have contributed base technology for collaborative programs. They see the US as reluctant to accept the need for help from abroad and feel that US industry can't do everything better than anyone else.

Australia has flown F-111 aircraft for over a decade after the USAF took them out of service; this required that the aircraft be maintained largely by the users. This included a major modification during which Australians maintain that International Trafic in Arms Regulations (ITARs) on releasability delayed their work. The Australian view was that such an interpretation is “madness,” since (among other things) it ignored the fact that such aircraft were available to protect and defend US interests in the region. Australians see their homeland as an unsinkable aircraft carrier in the middle of the Indian Ocean. They also operate the US F/A-18 aircraft, which helps keep a production base warm. Informed people recognize that Australian engineering firms can manufacture products requiring fine tolerances, and they believe that such capabilities have already been demonstrated in the JSF project.

The Australians consider the issue of operational sovereignty to be very important and feel that too much emphasis has been placed on "black box" security

issues. The point was emphasized that a qualified partner could work without opening a black box item if they were permitted to interface with it. On the issue of the aerial refueling tanker, the point was made that Australia was flying Boeing 707s, which had been modified by Israel Aircraft Industries, and that it was satisfied with the result. However, the view was offered that the US would be foolish not to split its current purchase of tankers on an equal basis, if for no other reason than to retain competition.

In contrast with the situation in some other partner countries, there apparently is no leading defense industrial firm in Australia. The most well-known domestic aerospace firm was Hawker de Havilland, which has since been purchased by Boeing. In addition, the F/A-18. There have been many changes in industrial structure in Australia during the past 20 years; these have resulted in the appearance of many new, small companies that may well find a niche in the market and a place in the JSF project.

Canada: The meeting with the Canadians began with a short side discussion of offsets in which the traditional economic view of them as being trade diverting and, hence, welfare reducing was challenged. The point was made that US domestic protectionism was unequivocally a source of trade distortion, which limited competition and gains from trade.

The senior person present agreed with the view that the philosophy motivating the JSF organization represented the latest stage in the continuing evolution of transatlantic defense trade and industrial policy related to military procurement. He contrasted the JSF approach with the traditional negotiation of work shares in Memoranda of Understanding between governments in earlier multinational defense acquisition projects. The JSF project was not considered an offset program in any sense. There is no mention of work share in any of the separate agreements negotiated with the US contractor. He described it as a “hybrid”,with different levels of engagement between partner industry and Lockheed Martin and the other major subcontractors. Canada developed a set of objectives

which included matching JSF program requirements with its own industrial capabilities. Part of the problem is that while Canada has a robust aerospace sector, Lockheed Martin appeared unaware of its capabilities. Canada had developed extensive contacts with McDonnell Douglas (and later Boeing) on its F/A-18 aircraft transaction and was well-integrated into that supply chain.

Another problem grew out of the fact that Canada's aerospace experience has been shaped by the production and sale of commercial aircraft. Bombardier's Canadair division had an established niche in the short- and intermediate-range commercial airliner industry. Canadian capabilities also existed in the production of turbine engines and landing gear. Since Lockheed Martin had almost no remaining representation in the commercial airliner business, it was not familiar with these Canadian competencies. The situation is further complicated by the fact that Canadian commercial aircraft producers have little interest in focusing on a fifth-generation fighter aircraft. Their suppliers were also geared to commercial aircraft with different requirements and different business approaches.

The Canadian government worked both to insure that Lockheed Martin and its major partner contractors obtained a full appreciation for Canadian capabilities as well as to target key sectors needing development and/or improvement to move Canada into a leadership role in at least some sectors of military aircraft. Such goals were aided by the fact that the Canadians had entered the JSF project at a sufficiently early stage to participate fully in the concept, design, and development activities. They anticipate that this will provide them an opportunity to participate in high-value parts of the supply chain.

Initially, Canadian officials expected that larger defense contractors (such as subsidiaries of US firms operating in Canada) would dominate in JSF activities in the country. They were surprised when, on the contrary, small- and medium-sized firms with innovative talents but with little or no prior history of participation in the traditional military supplier base, found themselves with JSF contracts. They see the JSF project as a massive development effort, probably the largest in trans-Atlantic

military industry cooperation, and welcome the opportunity to participate. If the expected sales volume is realized, Canada, despite its relatively small expected order of 80 aircraft, may be able to attain volume economies almost on a commercial level, which might have positive implications for the future.

The Canadian government was seen as taking a proactive role in both making the primary contractors aware of Canadian capabilities and encouraging their domestic industry to participate in the project. The respondents consider the underlying policy of seeking best-value sources wherever they are found within the partner community as both challenging and promising. The work of the Joint Program Office was singled out as an impressive collective effort of great value. An example was given of a Canadian Forces Colonel working with a British naval officer and reporting to an American general on matters of logistics. The Canadians saw this approach, if successful, as a model for future development efforts.

One source of concern was the US *Competition and Contracting Act*, which was seen as protectionist and a possible obstacle to the attainment of project cooperative goals. The respondents are hopeful that the “mobilization exception” clause of the Act may offer a way around the problem.

Denmark: The meeting began with a brief discussion of Danish experience with their F-16 Falcon buy. It was described as "a huge success over its 30-plus-year lifetime in every operational and commercial aspect.” The multi-national partnership worked well, and the larger group purchase (plus the partners’ role in US Air Force and third-country sales) brought the cost per plane down dramatically. It was emphasized that had the Danes bought a competitor aircraft, the costs would have been “colossal. “ It was described as “one of the most successful buys of the century for Denmark.”

On the operational side, a common aircraft among the partner states aided the formation and successes of a European Operational Wing during OPERATION ENDURING FREEDOM. While the partners didn’t fly or perform maintenance on one another's aircraft, software commonality was crucially important, and their prior

joint training during Operation Red Flag had valuable operational spinoffs. The Danes were also quite pleased with the results of their work in the F-16 midlife update.

In response to a question about the strength of the Pan-Nordic idea emphasized by Sweden in its attempt to sell the Gripen, the respondents expressed skepticism. They noted that since the end of World War II, it has been used as a political device to obtain cooperation and has never worked. It was emphasized that the security policies of Sweden, Denmark, and Norway were more different than generally realized. Sweden still shows signs of the non-alignment philosophy which dominated its foreign policy for so long, while Norway and Denmark have joined NATO to help its fellow members defend the region.

Even after the end of the Cold War, there were signs that Sweden still demonstrated a “garrison state” mentality. The Danes considered this an anomaly in an era of expeditionary warfare. They have apparently helped Swedish forces to realize the importance of tactics such as close-air support. The point was made that while Swedish forces are familiar with netcentric warfare, they are integrated only within their own forces, and are accordingly limited in their ability to engage in combined operations with friendly states. It was implied that the traditional Swedish approach to warfare played a role in the design of the Gripen aircraft, which may limit its usefulness in the contemporary strategic environment.

With respect to the future Danish needs, foreign suppliers will have to play a role. The post-Cold War peace dividend was marked by a decline in Danish defense expenditures. There is little left of the Danish arms industry. However, the F-16 spinoff brought growth to relatively small Danish firms, and many of them developed excellent capabilities. It was noted that the only non-US parts found in all F-16 aircraft are Danish.

The opportunity for Danish industry to participate in the development and production of the JSF appears to be a very attractive route for them to attain advanced technology. This may be important in helping smooth Denmark’s

transition from its traditional dependence on agriculture to modern industry. This development is seen as important to prevent (or at least slow down) the emigration of young Danish talent to other countries.

The competition for the new Danish aircraft appears to be among the JSF, the Typhoon Euro-fighter, and the Swedish Gripen. The larger Danish firms which benefited from the F-16 project will support the JSF. Sweden is offering significant industrial participation in the short run to make its offer politically attractive. It has already ordered small satellites from the Danish electronics firm Terma.

The Lockheed Martin offer is seen as highly competitive in terms of design and production. Danish and Dutch firms will bid for high-value-added processes such as electronic systems, but political forces will press for more "metal bending factories to provide more jobs in the short run to keep workers and voters happy." Our respondents saw the competition as a contest between short-run and long-run values. A Danish parliamentary commission has been established to define goals for the Danish military over the next decade. Any decision regarding new military aircraft will probably not be made until that commission issues its reports.

The Danes have no doubt that their air force will always be involved in coalition warfare and see an advantage in entering the US network. They see the UK, Australia, Canada, and several of their neighbors as traditional allies and want to be certain that they can connect with this network when needed. They see the new liberal government in Sweden as likely to continue to make sharp cuts in the defense budget, which suggests limited prospects for supporting further improvements in the Gripen.

In their judgment, the new generation of logistics will be much more cost effective, and the JSF appears closest to structuring a global logistics network to provide low maintenance costs and high availability. On the other hand, they consider it very risky to enter the US defense market due to US content laws and technology transfer regulations. They see the need to change US bureaucratic procedures as essential in furthering the effectiveness of coalition warfare.

Italy: Traditionally in multinational military projects, the government-to-government memoranda of understanding related the level of industrial participation to the size of the purchase. This occasionally forced industrial work to be assigned to less efficient firms which lead, in turn, to increased costs. It paid little heed to questions of efficiency. The JSF project attempts to limit the governments' role to the establishment of aircraft performance requirements, while turning the question of how such requirements will be accomplished to the industrial participants—in this case, Lockheed Martin, Northrop Grumman, and BAE Systems. The industrial goal, ostensibly, is best value for money.

Our respondent compared this arrangement to the Tornado and Typhoon projects. In the earlier Tornado project, major cost increases were incurred in order to meet the performance requirements. The administrative structure was anything but efficient—with the three partners (each a sovereign state) at equal levels with no prime contractor to mediate differences. This resulted in multiple assembly lines, multiple training systems, etc. This contrasts to the JSF project where Lockheed Martin, by exception, may name a second source.

In the Tornado and Typhoon projects, work level was assigned administratively, so there were few incentives to keep costs down. In the JSF project, all partner firms must struggle to keep costs down. They must understand the bidding process. Governments do not control the industrial arrangements.

There are, however, political problems that still create difficulties. The US ITAR rules on nondisclosure, for example, complicate an already difficult situation. Parliaments in partner states will resist financing projects which they see as strangling their domestic industries.

US rules that appear to be doing this will be a source of strong conflict. Realistically, some bargaining will surely be necessary over partner access to what is viewed as necessary information. Our respondent noted that Boeing has faced the same problem on the civil side, with much work on the 787 going abroad. Some lobbying is probably underway on this issue.

Multinational projects have also suffered from delays. It took so long to develop aircraft in the past that they were obsolete when the services took delivery. The JSF program's challenge is to prevent this condition from occurring while providing for long-term needs. The strategic scenario was relatively stable during Tornado development, but the Typhoon faced a more volatile situation. It was seen originally as an air superiority fighter, but halfway through its development the strategic situation had changed drastically. The Typhoon partners were no longer dealing with a clearly defined potential enemy. The Typhoon was not flexible; a major redesign was necessary, which caused further delays in its operational availability.

Italy saw some important values in the JSF. It was born as a fifth-generation fighter; it has new capabilities and is more deployable and flexible than its competitors. While this aircraft is seen with a prospective life in excess of 40 years, the project includes a commitment to update and improve its systems periodically. Thus far, JSF has exceeded expectations, and the Italians are pleased with their role in development work. They like the arrangements for all partners working together to decide, periodically, what the next block of the aircraft will resemble.

The JSF competitors are the Typhoon and the Gripen. Italy sees the Typhoon as an air superiority fighter designed for homeland defense. It lacks an out-of-theatre, air-to-ground capability which future coalition warfare will require. Our respondent entered a caveat, however, that other goals also need decision-makers' consideration. He cautioned that purely military considerations are not enough. There are also matters of jobs as well as political independence requiring freedom in use if the Italians buy the product.

An alliance is a matter of choice, and the EU is also seeking an important strategic role. While shared values and cooperation are important, Italy wishes its own industry to be independent. The respondent conceded that balancing these goals was not easy. He also interjected that technology often moves in two directions, and that Italy has transferred European technology to the US.

Our respondent indicated that, so far, Italy was satisfied with the JSF experience, but that there is much room for improvement. Industrial participation is a major issue. He described Italian industry as hungry for work and emphasized that it is pointless to ignore the relevant political issues: Europe vs. the US, and cost vs. release of technology. Also, Italian industry is accustomed to priority going to partners in the offset environment.

In response to our questions whether the major Italian holding company, Finmeccanica, will play the role of traffic cop guiding contracts in Italy to particular divisions, he observed that each company and industry makes its own decisions with each bidding separately for work. However, he conceded that there was a synergy within the organization, and the individual pieces would typically form an alliance rather than compete. He also noted a potential problem when partner companies on the JSF are also members of other consortia with non-JSF members.

Under such circumstances, it may be difficult to maintain a firewall keeping JSF technology completely separate and confidential. This is especially true when dealing with other Finmeccanica units. Finmeccanica participates in several multinational projects and is interested in maximizing the number of jobs and industrial activities of its units. It has influence with the Italian Government and the selection of particular weapon systems that it finds most attractive.

The respondent noted the JSF supply chain will be different from those in prior projects. He emphasized that the bulk of the business is to be found not in production but in maintenance over the life of the aircraft. Thus, lifecycle costs are what sell the product. The structure of the JSF organization stresses long-term sustainment, and there is no reason why industry can't share in this aspect of the project. (A major problem with the Tornado was that it was originally built with little or no thought about maintainability.) More attention has been devoted to the issue of logistics in the JSF project, but he felt that there is room to improve the design to improve sustainability. He added the thought that there are opportunities in the JSF

project to involve small and previously non-defense-oriented companies to the teams in Italy.

The Netherlands: The Dutch defense budget dropped substantially in the post-1989 period, which brought a significant consolidation in the structure of the Dutch defense industrial base. One result was the decline in the number of "pure" defense firms. A strategy was needed to reorganize the defense-related industries.

The first step was to build a strategic relationship that would help firms to better cooperate in the search for providing better value for money. It was necessary to realize that defense firms operate in a negotiated rather than in a competitive market. Furthermore, firms operating in the defense market could no longer depend on a constant stream of government defense orders. Thus, many of them faced the choice of selling out or attempting to diversify.

Those that survived made the transition to a much more competitive environment. Some searched for offset credits outstanding to improve their sales prospects. Others recognized the political costs of offsets such as the US ITAR regulations on third-country sales, which restricted where Dutch firms could sell items containing even the smallest amount of US parts or technology. Such rules discourage firms from selling to the US DoD or cooperating with projects which make them subject to such regulations. Since technology has grown very rapidly in the commercial sector, the development of new models for such markets appeared more attractive than the traditional defense market. Our respondent saw the US-controlled export control system as more damaging than protective of US interests.

The JSF program appeared to represent a new philosophy for US defense procurement. Contract awards supposedly will be made by the principal contractors on a best-value-for-money basis. However, a steering committee of the JSF project will provide support on industrial matters. Our respondent made the point that for all participants, the cornerstone of this program is the ability of each partner state to deal on a bilateral relationship with the US (on a government-to-government basis)

on matters of industrial participation rather than to go through the Joint Program Office.[41]

Our respondents also complained that not all partners shared equal access to technical data. They were assured, however, that after a few years into the development stage, additional data would be released. The point was stressed that the Dutch Parliament had invested a significant sum in the project as an entrance fee, but that no decision had yet been made on whether to actually purchase the F-35. It was hinted, however, that this might be a strategic game designed to keep the payee "on the ball."

With respect to potential industrial organization of a Dutch team, Stork Fokker AESP (as the principal aerospace firm) was likely to be involved, but many (perhaps 50) other Dutch firms had expressed interest through their willingness to pay an entrance fee to join a consortium devoted to acquiring work on the JSF.

Respondents noted that their historical experience with US aircraft had been positive, both operationally and logistically. The Dutch are confident of their ability to operate such aircraft, having had experience with interoperability, joint training, etc. They conceded that the F-35 was the only true fifth-generation fighter in the competition. Thus far, they are positively impressed by the concern shown over matters of logistics and sustainability in operations.

The Dutch consider this focus on post-sales matters crucial in a program expected to operate over many years. However, given the geographic scope of the partnership, they felt it would be very useful to consider the establishment of regional support centers. A final point made was the importance of The Netherlands

[41] This would be a way to circumvent the plans for this program and, thus, deserves attention. To some extent, it supports a point made by a Lockheed Martin executive that some partners had put pressure on the director of the Joint Program Office to attempt to influence Lockheed Martin's decisions on industrial participation.

Department of Economic Affairs, which was represented at the meeting and which works closely with the MOD on the JSF project.

Norway: The meeting began with a side discussion of whether Norway had noticed significant differences in its experience on the F-16 project when Lockheed Martin bought the F-16 operation from General Dynamics. Our respondents noted that there were few changes, as most of the staff assigned to the project remained unchanged. Long-term contacts had been established over the years, and Norway was very satisfied, especially in matters of operations and logistics. Indeed, the respondents' experience on the midlife update was much better than expected. They made the interesting point that the project "forced Americans to recognize that Europeans can cooperate effectively."

Stress was placed on the point that industrial cooperation on the F-16 was a success and helped Norway to develop new industrial capabilities, which became the foundation for its present high technology industries. They singled out Volvo Aero as a Norwegian success story. When the old Kongsberg group went bankrupt in 1986, Volvo stepped in and now owns 80% of the operation, with the remaining 20% owned by Pratt & Whitney.[42]

The point was made that Kongsberg had developed a Norwegian supply chain during the F-16 experience and would logically utilize it on JSF work. They consider the JSF a major improvement in the quality of air-to-ground application of air power. Its stealth qualities, while not outstanding, represent an improvement. Also, while it is not optimized for air-to-air combat, it is superior to the third-generation F-16 in that area. The important point was made, however, that Norway's primary goal in entering into the JSF project was industrial, not military. This was not seen as a uniquely Norwegian objective when it joined Denmark and the Netherlands in the JSF Concept Demonstration Phase with the US.

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[42] Apparently more effort is now going into civilian work.

While the JSF philosophy stresses best-value-for-money where only well-qualified firms will win contracts, the relevant question is how this will affect the industries of partner states? They also wanted to participate in the development of the new aircraft with its focus on logistics and cost control, but saw their participation as an opportunity for Norwegian industry to gain contracts. It was seen as a risk-reduction decision, as it would likely be a model for future international cooperation.

Therefore, the first major dispute was over the application of the US ITAR rules to the project. These nondisclosure regulations had been a problem for the Norwegians on the F-16 project, and these rules denied them entry into areas in which they wished to develop capabilities. While they were allowed some technology transfers in structural matters, engine work, and electronics, these were not at levels of system responsibility. The model was frustrating as their expectations as “partners” were much higher than what they obtained.

Under more traditional offset arrangements, Norwegian authorities would be the ones to decide where domestic industry has the capability to participate. Norway wanted to strengthen its capacities in those areas in which it felt it already had much to offer.

The present offers on the Gripen and Typhoon would deliver 100% offsets and give Norway a more prominent voice in industrial participation matters. This contrasts with the JSF, in which Norway is a minor partner with much less influence than the UK, for example. Offset arrangements would raise the possibility of Norwegian participation in other projects to which it might be able to contribute its competencies and strength.

The discussion then turned to broader economic matters, which helped the authors to understand Norway's reservations concerning JSF arrangements. In recent years, Norway has enjoyed strong economic growth that has yielded large budgetary surpluses. Oil exploration and extraction have played a major role in these developments. However, the country has shown concern about what will happen when its oil resources are exhausted.

The Norwegian government will soon have to present to its parliament a new industrial strategy designed to build Norwegian competencies to meet future needs. Our respondents felt that environmental and resource concerns can best be dealt with by strengthening existing competencies and developing new ones in advanced technology areas. Norway has a well-educated workforce, but its factory floor labor is expensive. Norwegian authorities are interested in working on high technology products, which will improve the general level of their industrial capabilities and will make better use of their skilled engineers and managers that are relatively inexpensive.

They are not attracted by the opportunity to increase factory jobs with relatively high labor costs; among other things, such an approach also doesn't improve Norway's ability to win contracts. The fact is that labor-intensive work is not an area of comparative advantage.

Another consideration is found in the respondents' belief that Norway is quite competitive in areas in which its industry has developed products. This should not be surprising since Norwegian firms design according to Norwegian comparative advantages in production. An example was given of the firm Nammo Raufoss AS, which produces ammunition. There are many producers of ammunition throughout the world, but Nammo Raufoss has attained success on the basis of its excellent design, which has provided a cost advantage over its competitors.

Some years ago, a Nammo Raufoss executive was not hesitant to attribute much of the firm's success to its participation in the F-16 program. His comments at an international conference follow:

> I will limit myself to speak about technology transfer […] What were our experiences? Well, our objective was to help technology transfer to support our existing production of defense material, which is ammunition, and to have some new technology for our civilian production. We have gained system management, which I think is important. We have some jobs in NC (numerically-controlled) machines which we did not have before. We have learned about forging high strength aluminum, which is important to us for our civilian production. We have learned about non-destructive testing, more

> than we knew before, and we have learned about the U.S. Air Force quality control system, which we also think is important. And, not least, we have gained close cooperation with new firms in the United States.
>
> I will add that in the beginning it was rather difficult to have our U.S. partners understand our objectives. So we had to use rather heavy persuasion to have them accept our wishes for technology transfer. But, after that initial period of some months, we must say that they have been most cooperative. So far the program has been a success concerning transfer of technology.[43]

Due to its high general labor costs, Norway doesn't produce shirts, shoes, ties, and other goods with which they would have to compete with China, for example. When other design processes are more labor intensive, Norway is not competitive. Thus far, the industrial aspects of the JSF program are not satisfactory for Norway. The respondents are disappointed that their ambition to enter the program at higher technical levels hasn't been realized. They are not attracted by the opportunity to produce high volumes of simple objects. The situation would be quite attractive if Norwegian-developed weapon systems were integrated into the project; indeed, this would make Norway's position more competitive. Norwegian requirements for firm, binding information from the present competitors were transmitted in January 2008. This information will be used to evaluate and rank the competitors in late 2008.

We then turned to examine the strength of the Pan-Nordic idea, which has been used by Sweden to make the Gripen a more attractive alternative. Its influence is rated as marginal, and more depends on the actual attractiveness of the offer itself—industrially and militarily. The two countries share a similar geography and concern with the Baltic region. Recently, the Swedish and Norwegian Commanders-in-Chief jointly authored an article on the importance of combined efforts. In general, cooperation with Swedish industry has been very good.

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[43] N. Tommeraas, "Comments", pp.258-259 on Bernard Udis, "Technology Transfer in the Case of the F-16 Military Aircraft," in Sherman Gee, *Technology Transfer in Industrialized Countries*, Alphen aan den Rijn, The Netherlands: Sijthoff & Noordhoff, 1979, pp. 245-258.

However, there are problems associated with closer military cooperation. For example, Sweden has a much larger and diverse defense sector, which reflects its traditional emphasis on self-reliance in defense production. While the Swedish military budget has declined faster than the Norwegian (bringing the two closer in size), Sweden still has one of the six largest defense industries in Europe. Thus, successful industrial participation could lead to a restrictive division of labor and industrial capabilities in which Sweden would have to sacrifice some part of its industrial complex. To develop an industrial package, Sweden would have to find a way to make room for Norwegian participation. The respondents felt it would be better to set plans for Norway to participate in the next-generation Gripen. They would find this more attractive than work on the JSF, which they found not "noble."

Interestingly, the concept of regional support centers (which was raised in the Dutch interview) was raised independently by the Norwegians, who saw some logic in close cooperation with such states as The Netherlands, Denmark, and perhaps Italy.

As an addendum, it should be noted that years ago in the offset environment, a major French defense firm directed its engineering staff to reexamine its production layout to locate areas in which potential customers could be offered offset work with minimum difficulty. One wonders whether a similar method might find a way to integrate Norwegian design into the JSF project. Our impression is that Norway is seriously considering departing the program as presently structured.

This impression is strengthened by a recent statements by government officials which stress the importance of "strict offsetting requirements" in their ultimate contract award and the Norwegian government's expectation that Kongsberg Defence & Aerospace (KDA) would receive, as it had in the past, the largest part of offset agreements concluded in Norway (O'Dwyer, 2007, December 10, p. 12). Espen Barth-Eide, Undersecretary of State at the Norwegian Ministry of Defense (MOD) was quoted recently as saying, "Whether fighter type is chosen, Norway will still demand investments, either offset or the JSF development program.

We will look for real industrial participation, regardless of its name." (O'Dwyer, 2008, Jan 14, p. 18)

Perhaps it is merely a matter of semantics, but, high-ranking Norwegian government officials demonstrated little regard for two basic principles of the JSF program: that value for money rather than guaranteed work shares (offsets) would determine assigned work on the program and that the US principal contractors would have final say on the selection of participating firms.

Turkey: The discussion began with a brief review of Turkey's experience with its F-16 aircraft. In general, the Turks appear to be happy with the F-16. They have encountered no major problems and are satisfied with the program, particularly with the industrial participation aspects. Thus far on the JSF project, however, they are not very happy—especially with the work assignment experience. The Turks are now involved with Lockheed Martin in talks designed to obtain more benefits for their industry. They are also considering offers from the Typhoon group that involve some clear opportunities for industrial participation.

The JSF is a "more powerful aircraft" than the Typhoon and will therefore probably be chosen. Our respondent noted that the JSF aircraft is a completely different product than the F-16 on the operational side, although the same firms would likely participate in both projects. This is because Turkey lacks a large, developed aerospace sector. Turkey's most important firms are TIA on the airframe side, TEI in engine work, and ALP for special engine parts and components.[44] There are, perhaps, three firms involved with software.

In contrast to partner states with a more advanced industrial sector, the Turks don't expect non-defense firms to find a significant place in the supply chain for the production of an advanced aircraft like the F-35. Our respondent emphasized

[44] In an earlier meeting with Lockheed Martin executives, TIA was described as "a real success story," based, apparently, on its record in the F-16 project.

Turkey's lack of experience in aviation work and was reluctant to speculate about its future role in the JSF project.

United Kingdom: Our UK respondent began the meeting by emphasizing the importance to Britain of the STOVL variant, noting that the UK's very large investment in aircraft carriers depends heavily on its successful development. He noted as well that the Royal Air Force is quite interested in STOVL aircraft which could be launched from shipboard. The respondent appeared proud of the rather widespread use of Harrier-type aircraft in the US Marine Corps, and the Spanish and Italian navies, in addition to their utilization in the British Royal Navy and Royal Air Force.

He emphasized that rapid changes in the strategic landscape had made extended delay between design and delivery of weapon systems intolerable and gave the Typhoon as an example. Today, the speed of change in technology has led to technological compression, which makes equipment obsolete before it is delivered to the services. Yet, the British MOD must have some idea of what future technology will look like. The military is no longer pushing the market to meet its technology needs; rather, it is struggling to keep up with rapid market innovations developed for the commercial sector.

The UK is the only Level I partner in the JSF project and has made a substantial investment, which it hopes will bring an adequate return. Much is riding on the success of the project for Britain. Nevertheless, no commitment to buy will be forthcoming unless the support strategy is clearly determined. Our respondent seemed to believe that the Joint Program Office has excellent people working to solve some of the major problems encountered thus far.

The notion that each nation's industry must compete to win contracts appealed to him, especially when compared with the Typhoon experience—in which the assigned work share was "calculated to several decimal places" with grossly inefficient results. Nevertheless, some lessons were learned which allowed some improvements in the Typhoon over the earlier Tornado. Some of these were

administrative in nature. Spain, the new partner in the Typhoon program, learned some lessons from watching Italy's experience with that aircraft. The most important was that it was tough to be a minority stockholder. Determined not to be the "new little boy on the block," Spain began to exert its influence early in the project. The unanimous decision rule was adopted for some decision-making in the Typhoon program, although not for all.

Our respondent noted that unanimous decision rules were difficult and observed that in the EU, a form of qualified majority voting was now in effect. The source of funds from Spain in this project came from the Ministry of Trade and Industry, not the MOD, so the interest in work share and jobs was unmistakable. By contrast, decision rules were firmly established in the JSF project from the beginning. Our respondent observed, "Since the US was providing approximately 90% of the investment in this project, its desires were driving the program." Still, no nation has yet committed to purchase the aircraft and is not likely to do so unless it first is satisfied with such factors as cost, delivery date, capabilities, etc.

The conversation then switched to the question of operational sovereignty. Our respondent expressed the opinion that US laws dealing with export control were more complex than necessary to accomplish their objectives. He expressed the belief that they were unnecessarily detailed on items like components and are applied to commercial items as well as military. His statistics showed that in the year 2006, license applications were submitted for 8500 items worth something like $14 billion in UK-US transactions, and that 99.8% were approved. It is well known that the UK is not a threat to the US.

He conceded that on occasion, in the past, mistakes were made; in his opinion, both sides were to blame. He expressed the firm belief that for export success to be attained, technology sharing is essential. He felt that complications resulting from such rules have caused delays in getting essential items into the hands of the warfighters. At the time of our meeting, however, he appeared optimistic about resolving such problems. In his judgment, it is essential for each

party to fully understand what the other expects. He appeared optimistic that recent problems have been solved, although he cautioned that changes won't occur immediately and that it will take some time for the details to be worked out.[45]

Our respondent's optimism was, in part, a reflection of his confidence in the top British negotiator, Lord Drayson—the MOD's procurement chief. He noted that Drayson was very experienced in commerce and industry, having developed his own very successful pharmaceutical firm. The respondent felt Drayson had "brought clarity of thinking to the MOD on procurement matters, with, among other things, his understanding of Intellectual property rights issues." If this very favorable view of Lord Drayson's talents and his importance to these delicate negotiations is correct, a new degree of uncertainty may have been introduced by his abrupt resignation from his MOD post on November 7, 2007 (Chuter, 2007, November 12, p. 1).

Our respondent was firm in his belief that the UK does not want to experience the problems encountered by the F-16 partners when they desired to change the capabilities of the platform, and, in particular, to introduce different weapon systems. In his view, operational sovereignty requires that the partners know how things work on their aircraft to permit them to handle issues of maintenance and modification without awaiting the arrival of an American engineer to guide them through the job. For the UK to continue to participate in the JSF program, it requires a government-to-government agreement that provides such conditions. A bilateral document was signed in December 2004, but his government felt the need for additional assurances, which he apparently believes were obtained in a joint document agreed to by then-Prime Minister Blair and President Bush in late 2006.[46]

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[45] This caution was seconded by some Lockheed Martin executives who expressed the opinion that certain crucial technologies involving weapon systems and electronic warfare devices would "never" be transferred abroad and that such matters would have to be resolved on a case-by-case basis.

[46] For a recent report on efforts to work out critical details, see Chuter (2007, November 26, p. 4.)

The three major partners on the airframe are Lockheed Martin, Northrop Grumman, and BAE Systems. But from our respondent's perspective, even BAE must win participation rights based on efficiency criteria. This has potential supply-chain implications as it suggests that periodically, bids may be received from interested parties "throughout the world."

This is a new business model in a world which operates largely on offset rules. It requires the UK to be thoughtful about some market decisions. The UK is known as a good place to do business, and firms such as General Dynamics, Lockheed Martin, and Northrop Grumman are familiar with British capabilities. It does not have "national champions" which need to be protected.[47]

The respondent expressed a negative opinion of offsets in defense trade and viewed them as a cause of higher prices as they "allowed firms to become dysfunctional." He saw defense firms as no longer operating in a conventional market in which hardware and platforms dominated. Rather, he saw a current focus on networks. There were other significant changes in UK industry noted. For example, trade protectionism is declining—except, perhaps, in warship production. Even here, a recent order for roll-on, roll-off ships went to Germany. There are two aircraft carriers on order now, but their expected lives are fifty years; thus, the future market for major naval vessels is very thin. Of the top ten direct suppliers to the British MOD in 2004/2005, almost half were headquartered abroad, and four were not traditional defense contractors.

The administrative costs ("baggage") associated with producing for the defense sector are now significant, and small- to medium-sized firms with advanced technological capabilities have other market opportunities which appear more attractive. To counter such problems, the MOD has attempted to establish partnering arrangements with the civil sector. For example, the Royal Air Force

[47] This may be true today, but for years, Rolls-Royce certainly appeared to be considered as a "national champion" in British aerospace projects.

(RAF) is generally able to conduct normal peacetime operations with seven or eight aerial refueling tankers, but maintains several times that number to cover emergency possibilities. They lease the surplus numbers for civilian use but retain the right to recall them when necessary for military purposes. Pilot training that has long been undertaken by the military is now experiencing surplus capacity; it is now being used to train pilots for the military forces of friendly nations as well as for commercial airlines. Such alliances are viewed as a way to share risks and benefits.

Another point of uncertainty concerns the role of Lockheed Martin in the area of maintenance and sustainment of JSF aircraft. The UK has not yet accepted Lockheed Martin's proposals in this area, and the task is substantial. Support must be provided for the needs of multiple air forces. This will involve meeting the different needs of different nations. There also is talk of updating and improving on a biennial basis; the respondent feared such changes would interfere with the stability of operations.

An issue which arose several times during the meeting dealt with the British desire to exert influence on the direction of the project consistent with the size of its investment. There also were repeated negative references to the F-16 process, which the respondent took to mean that the "partners" were presented with a *fait accompli* when it came to design of the aircraft. On the other hand, he indicated that the British contributions have been welcomed thus far in the JSF program.

The British are attracted to the guiding principle of best-value-for-money and are willing to play by the rules. If a British firm wins a contract, UK authorities will, of course, be pleased. However, if a superior offer comes from another partner, they will certainly be willing to go along with the decision. They recognize that the aircraft will not be affordable unless work is performed in the best possible industrial framework. They expect a club of FMS customers to develop in the future and consider the product as too expensive for the US to produce by itself. We took this to mean that the British see quite a market developing in the future for third-country sales—in which they see attractive opportunities for their involvement.

3. Understanding the Joint Strike Fighter Project

A Post-offset Future? The Joint Strike Fighter program appears structured to operate in an offsets-free mode. An international consortium of (unequal) partners is responsible for developing the F-35. Selection for production work is completed mostly on the basis of best value (efficiency). Is this a model for a post-offset future?

In a real sense, the current discussion echoes some old issues. The major objection to offsets is their trade-distorting properties, i.e., their inefficiency. One defense of offsets is their ability to reconcile a number of groups with differing objectives—a sort of equity case. The JSF concept strongly emphasizes efficiency. The Partners' reactions are interesting. It appears that there's a strong consensus in favor of applying efficiency criteria to other partners (free, efficient trade) while understanding the need for themselves to be treated equitably (fair trade?).

Transaction Cost Economics: Delaying the Fundamental Transformation. International trade in defense goods frequently involves a special class of outsourcing relationships. That is, portions of the product in question are outsourced to firms within the customer's national boundaries. These purchases can take a variety of forms—from participation in the product's supply chain to licensed production of finished systems.

From the exporting firm's perspective, a variation of TCE's fundamental transformation has occurred in this case. Instead of a standard commercial purchase, a firm-to-firm relationship has come into existence. After the terms of the sale are negotiated, the supplier is bound to a firm tied to his customer. There is accordingly scope for opportunistic behavior: in this case failure to produce efficiently.

In this context, the aim of the JSF project organization is intended to keep a competitive market in place as long as possible, since participation in JSF production goes to the supplier offering best value. How long it will be possible to

delay the fundamental transformation from competitive market to long-term contractual relationship has yet to be determined.

Corporate Strategy: The JSF project's organizational scheme fits well with the prime contractor's strategic aims. From a Five-Force perspective, any defense industrial firm must be concerned about buyers' power—the buyers being sovereign states. The JSF mitigates this threat to profits by changing customers into risk-sharing partners in a very real sense. The aim is for the main customers to become stakeholders (albeit minor) in the overall venture to better align incentives.

B. Emergence of the UK Defence Industrial Strategy

Increasingly, US major defense acquisition programs involve some degree of participation by foreign firms. Major US defense programs in early stages of development, such as the Joint Strike Fighter discussed above or the proposed KC-30 tanker, include major participation by European firms.

The trend toward foreign acquisitions is not new; the US Army acquired the de Havilland Canada C-7 Caribou transport aircraft in the 1960s, and the Marine Corps acquired the British Aerospace-designed (McDonnell Douglas-built) AV-8B Harrier II combat jet, with Rolls-Royce engines, in 1985. However, the increasing complexity of modern weapon systems—including the sophistication and integration challenges related to software, hardware and mission platforms—has raised major issues and legal challenges in the implementation of transnational partnerships in which the US is involved. At the heart of many of the transatlantic conflicts are "profound differences in strategic outlook between the United States and Europe" (James, 2006). Yet, it is important to understand how the defense acquisition and industrial relationship can best be managed.

1. Globalization and the Defense Industry

International trade in military products has featured a variety of objectives for the buying country. Pursuit of these objectives was frequently embodied in contractual requirements for offsets. However, there seem to be a number of

changes to traditional modes of behavior—with the emphasis on “industrial participation” moving to the fore. The goal of industrial participation can certainly include offsets, but achieving it may well entail changes in strategy and behavior. More emphasis is placed on specific technology access and industrial partnerships (which represent a long view of national capabilities), and less on general economic benefits (such as those provided by offsets), which may prove to be short-lived.

Industrial participation may also constitute a more sophisticated approach to the international defense marketplace. The buying country’s level of expertise, its strategic policy, its size, and geographic location should influence goals for its defense aerospace industry. Rather than short-term benefits (such as assembling the aircraft in the buying country), the same nation can promote the development of expertise in a specific set of technologies (such as radars or landing gear). Markowski and Hall (2006) effectively summarize the challenge:

> However, subsidized investments in defence-related industry capabilities are unlikely to provide a good return on taxpayers’ capital. As we argued earlier, small countries such as Australia can ill afford to pay import-substitution premia when they offer poor prospects of sustained future work and little scope for inter-sector technology spillovers. (p. 61)

As an illustration of emerging trends, the US is heavily dependent on the UK as the only “Tier 1” partner in the JSF program. As of March 2006, the UK had invested over $2B in the JSF (US General Accountability Office, 2006; Congressional Research Service, 2007). Yet the US continued to refuse to provide access to certain critical technologies necessary to operate, maintain, and upgrade the aircraft, and intense discussions were needed between the two governments to resolve the issue (Chao & Niblett, 2006). Finally, after years of negotiations, the issue was resolved by creating a “perimeter” around the two countries’ governments and defense industries (Bruno, 2007). As the largest export customer for the JSF, the UK can play a major role in reducing program costs through larger production runs, as well as in providing an interoperable fleet. Additionally, Denmark, Italy, and The Netherlands are also contributing to the JSF as lower-level EU participants, with smaller financial commitments.

With the US defense market becoming potentially more contestable, we have seen strategic alliances forming between foreign and US defense industrial firms for the purpose of securing US business. A good example is the EADS-Northrop Grumman team offering the KC-30 aerial tanker. It is entirely possible that marketing defense products to the US involves different strategies than, say, US firms in selling to European nations. A more "political" model of rent-seeking behavior might be more useful.

2. The Issue of Appropriate Sovereignty

The UK government is well aware of the conflict between the US's concern about technology protection and the perhaps too-common perception that *all* foreign countries are perceived sources of security leaks and terrorism. The *Defence Industrial Strategy* or *DIS* (UK Ministry of Defence, 2005) is emphatic about the requirement for the UK to remain interoperable with allied forces, particularly the US. It is equally clear about the need to preserve national autonomy in operating, maintaining, and upgrading weapon systems. For example, the *DIS* chapter dealing with systems engineering includes the following section:

> *Operational independence and being an intelligent customer:* Systems engineering capability is central to understanding whether the system will operate as you want it to, when delivered, and as it evolves through life; it may not always be possible to tell this simply by independent testing. This applies both for initial purchase and for support and upgrades. Having reliable access to this capability within the UK, particularly for Urgent Operational Requirements, is generally a high priority.
>
> *Avoiding the "captive customer" risk:* Relying on an overseas platform systems engineer could limit the ability to develop and upgrade equipment to meet unique UK requirements, unless there are credible and clear contractual and political guarantees. In some areas, we may be prepared to share sovereignty here. But in the worst case, reliance on an overseas systems engineer could lock us into having to agree to inappropriate, unwanted and expensive changes in configuration, or risk the systems engineer withdrawing support from older variants.
>
> *Strategic industrial influence:* Without an onshore candidate platform systems engineer, our negotiating leverage in procuring equipment competitively in the global market would be markedly reduced and we could be exposed to overseas monopolies. And in cooperative programmes, it is important to be

able to participate meaningfully on an equal or near-equal footing with international partners.

National provision: In some areas, overseas sourcing is impossible, for legal or security reasons. The ability to develop such systems has to be maintained on shore. (UK Ministry of Defence, 2005, p. 62-63, emphases in original)

The fact that the nation often referred to as America's most important ally has chosen to adopt a guarded attitude—the 145-page *DIS* has only a small number of passing references to the US—is indicative of the fact that the UK and (one can reasonably assume) the other European allies have clearly taken note of the post-9/11 US position on exports. The *DIS* breaks down weapon systems and component into three categories:

- strategic assurance (capabilities which are to be retained onshore as they provide technologies or equipment important to safeguard the state, e.g., nuclear deterrent);
- defence capability (where we require particular assurance of continued and consistent equipment performance); and
- strategic influence (in military, diplomatic or industrial terms), as well as recognising potential technology benefits attached to these which have wider value. But as the *DIS* makes clear, even where we wish an industrial capability to be sustained in the UK for strategic reasons, that does not necessarily preclude global competition in that sector for some projects. (UK Ministry of Defence, 2005, p. 7)

The *DIS* is important for at least two reasons. First, it catalogs and then categorizes the full range of weapon systems used or contemplated to be used in the foreseeable future by the UK. Second, for systems that continue to be produced in the UK, long-term relationships with suppliers encompassing each system's full lifecycle are contemplated. In effect, competition is set aside in the long-term national interest.

3. State Intervention or Status Quo?

While the initial reaction to this policy making might lead the reader of the *DIS* to say that the UK is beginning to look more like France with its firm *dirigisme* (rigid national industrial policy), some context is called for. While the UK defense budget

is the largest in Europe, it remains tiny compared to that of the US. Second, even the US does not practice competition in a number of areas. For example, aircraft carriers are only built at Northrop Grumman's Newport News shipyard in Virginia. Seen from the British perspective, a smaller budget and a wide range of defense responsibilities lead to market failure because neither the domestic market nor potential exports are sufficient to maintain enough producers to compete. And the US now has only Boeing and Lockheed Martin capable of building fighter or attack aircraft.

Boeing is building only a small number of the EA-18G Growler electronic warfare aircraft (a variant of the F/A-18F) as well as a few F/A-18 E/Fs for the export market, with no future fighter or attack aircraft orders from DoD on the horizon. Lockheed Martin, currently completing its order of the F-22 Raptor and also as the prime contractor for the JSF, will soon be now the only domestic prime contractor for fixed-wing fighter aircraft.

Second, the *DIS* appears to confirm (if not guarantee) the *status quo* in many sectors of the UK defence industry. In that vein, the Ministry of Defence signed a "Foundation Contract" on March 1, 2007, with its largest supplier, BAE Systems. Subsequent work by both parties was expected to lead to a "full and legally" binding contract (Long Term Partnering Agreement) in the near future (UK House of Commons Defence Committee, 2007c). Not mentioned in the *DIS* specifically, but definitely in the background is the already significant cross-investment in defense industries between the two countries:

> Furthermore, over the last decade, the U.S. and UK defense industries have established a significant physical presence in each others' country. This has reflected the political imperative of needing to be able to compete "on shore" for contracts in each other's markets. Many of the major U.S. defense contractors have established or acquired operations in the UK, including Lockheed Martin, Raytheon, General Dynamics and Northrop Grumman. There have also been significant acquisitions in the UK by second tier US aerospace/defense firms. In total U.S. companies have bought 27 UK aerospace/defense firms worth $5.1 billion over the last five years, representing a little over half of all the U.S. investment in foreign defense assets. Meanwhile U.K. companies have acquired 50 aerospace/defense

> firms in the United States worth $7.3 billion since 2001, equaling three-quarters of all foreign investment in the U.S. defense sector. And there have continued to be significant acquisitions by the second tier back and forth across the two countries. (Chao & Niblett, 2006, pp. 20-21).

Emphasis on stability and long-term relationships is the dominant feature of the *DIS*. For example, small helicopters (currently made in the UK) are considered an essential onshore capability, while large helicopters (such as the Boeing CH-47 Chinook) are not. Bombers and transports (which have not been produced in the UK for some time) are viewed as easily available offshore. Lewis Page (2006), a well-known British critic of UK acquisition policy, has argued the following in a somewhat flippant manner:

> Once one has lifted up one's head from the disorienting fantasy world of the *DIS* and smelled the coffee, one does notice a curious coincidence. The government's top brains, after months of careful pondering, have—and this can only be a remarkable coincidence—determined that the precise capabilities which are key to an appropriate British sovereignty just happen to be the very ones which are present onshore at the moment. How amazingly fortunate! Nobody will have to be fired; nothing nasty will happen to any British civilians; no minister need exhibit any backbone. There might even be some money left over to buy the real stuff from the Yanks, albeit not very much of it. (p. 1)

The *DIS* is indeed easy to criticize as a lengthy exercise in cataloging and justifying the status quo; yet it also represents a clear prioritization of defense spending that is necessary to all nations.

5. The A400M: Onshore or Offshore?

The exclusion of airlifters from onshore manufacturing, as stated previously, looks obvious. Britain has not built such aircraft in many years and obtains its cargo aircraft from the US. But in the same vein, Britain has become involved as a participant and buyer of the Airbus A400M transport and the *DIS* exclusion of this type of system from onshore production may confirm the wisdom of avoiding the creation of a UK industrial base for large aircraft.

The A400M can best be described as a hybrid in size and function of the C-130J and the C-17. It is interesting that since the RAF has bought both of these US

products, it is also committed to buying a number of the A400M—although private discussions have revealed that the UK no longer needs this European airlifter and is trying to reduce or eliminate its commitment for 25 of the type, down from the original 45 agreed to with partner nations in 1982. The lack of UK requirements stems mostly from the fact that the RAF has acquired five C-17s and 25 C-130Js.

If the A400M were added to this mix, the UK would find itself with what has been described as “an incredibly complicated airlift fleet” (Aboulafia, 2003, 16). The A400M was officially launched in 1982, and the Europrop International (EPI) TP400-D6 engine was selected in 2003. Delivery of the first test engine, originally scheduled for the fall of 2007, will now be at least a year behind schedule (Aboulafia, 2003; Barrie & Wall, 2007).

Given the drawn-out production schedule and engine problems (particularly for a transport aircraft), and the eventual cost to the European nations that actually buy the aircraft (should it reach production), the wisdom of leaving the field to the US makes eminent sense from the UK’s perspective. Yet the UK is trying to determine what is possible and practical.

However, for countries such as France and Germany, having a European airlift manufacturing capability trumps other considerations. And with BAE Systems having sold its share in Airbus, there is no longer any British corporate investment in the A400M, although many UK suppliers continue to be involved. Indeed, Marshall Aerospace of Cambridge is scheduled to test the A400M engine once it is ready. Currently, nine nations have orders for a total of 192 of the A400M, down from 297 at the launch of production in 1982 (Aboulafia, 2003; Barrie & Wall, 2007). The syndrome of multiple and lengthy production delays is common for combat aircraft, but is somewhat surprising for a cargo aircraft. Furthermore, A400M production problems may have clouded the need to adequately plan total lifecycle support, a cornerstone of the *DIS*. The following excerpt from a parliamentary report is telling:

> 91. In its memorandum Marshall Aerospace stated that the A400M would provide a significant boost to the MoD’s air-lift capacity, but raised concerns

about the MoD's approach to supporting the aircraft as it could see "no evidence that the MoD is taking due account of the sovereignty issues for A400M, as specified in the DIS." We asked the MoD about the arrangements for supporting and maintaining the A400 aircraft when it enters service. The development and production contract with Airbus includes some support provision, but was not "a full support solution of a modern kind." Mr Rowntree said that further work was being undertaken to consider what the support solution might look like which included looking at "possible collaborative and UK national options."

92. We sought confirmation that the support arrangement would provide the UK with sovereign national capability. Mr Rowntree said that the design authority for the aircraft was not "at the moment UK-based" and this required the MoD to make sure that there were arrangements with an "onshore expert provider….and we are working, along with a number of suppliers, to make sure that we make those right decisions to keep the capability we need." He considered that there were certain elements of the support arrangement that "sensibly should be pan-European." **The MOD is undertaking work to identify a support and maintenance arrangement for the A400M aircraft when it enters service.**

The MOD needs to ensure that the arrangement identified provides the UK with operational sovereignty. (UK House of Commons Defence Committee, 2007c, emphasis in original)

The ongoing A400M saga provides some insight into the UK's perspective with respect to the defense spending priorities of its European neighbors. In the first nine months of 2007 alone, EADS lost €705 million on all its activities, including the A400M and the A380 superjumbo airliner (El País, 2007b). The *DIS* appears to be an attempt to combine long-term realism in terms of technology capabilities and spending constraints with recognition that sourcing offshore, whether from the US, Europe, or elsewhere, is in the UK's best interests. We will discuss the challenge of the defense procurement relationship with the US in more detail below.

An illuminating example along these lines comes from Spain, which has developed a small and tightly focused defense aerospace industry. A good example is CASA Aerospace, the Spanish division of EADS that has developed the CN-235 family of twin-engine aircraft, which remains in production. Over 250 of these turboprops have been sold to the armed forces of 23 countries, including the US Coast Guard, which is acquiring between 20 and 36 of the aircraft for patrol and search and rescue as the HC-144A. However, the first customer for the aircraft was

the Spanish Air Force, which had a clear requirement and ordered 20 between 1988 and 1990, which served as a basis for export sales (Jane's, 2007).

Spanish defense acquisition policy is based on one overriding principle. The needs of the nation's armed forces determine industrial policy (Ministerio de la Defensa, 2007). Spain does not fund the development of technologies or manufacture of weapon systems intended for other countries -- after having been through several iterations of defense industrial policy beginning with the offset-based acquisition of the F-18 A/B in the early 1980s. Spain's domestically grounded policy, which is based on a 15-year acquisition plan (Ministerio de la Defensa, 2007) has been described as follows:

> International mergers and acquisitions can provide a more structural link to foreign partners and integrate the domestic industries within international production networks. Yet, if the defence authorities wish to retain and improve specific technological capabilities, they may be compelled to provide a stream of domestic projects to sustain specific capabilities that may already exist in other countries. The involvement of foreign partners in Spanish defence production is directly supported by the domestic market. (Molas-Gallart, 2006; pp. 103-104)

Both Spain and the UK have recently developed defense aerospace acquisition policies that are portrayed by their governments as: based on military requirements, affordable, and meant to provide long-term stability to domestic industry. Yet the size of the UK's military, by far the largest in Europe, and its shared interests with the US continue to drive unique decisions, which we will discuss in the next section.

6. The UK-US Special Relationship Continues

While crafting its own roadmap to "appropriate sovereignty," the UK wants to retain the "special relationship" with the US it has enjoyed since World War II, while continuing to cooperate with other EU nations to produce a wide variety of weapon systems. Maintaining US-UK trust has proven a challenge since 11 September 2001. The Bush Administration's 2002 *National Security Strategy* has the stated goal of "maintaining technological superiority over all potential adversaries as a

central national priority" (Chao & Niblett, 2006, p. 24). Despite what can only be described as the most loyal and intense cooperation possible with the US, the UK, post 9/11, perceives itself a victim of an emergent xenophobia in certain Administration circles; no country can be trusted, whatever the situation and the historic ties.

This behavior has led to deep skepticism within the UK about the true willingness of the US to "partner" on the JSF and share the technology that will permit the "appropriate sovereignty" envisaged by the *DIS*. The following exchange in the UK House of Commons Defence Committee between Member of Parliament Bernard Jenkin, Committee Chairman James Arbuthnot, and Lord Drayson, then Minister of Defence Procurement, is an interesting indicator of the current climate in Britain:

> Q104 Mr Jenkin: Can I just ask a short supplementary on technology. In the discussions with the United States about technology sharing, do people over there express anxiety about us sharing technology with our European partners and, therefore, the United Kingdom is potentially a leak into Europe?
>
> Lord Drayson: Yes, they have expressed that concern.
>
> Q105 Mr Jenkin: What do you have to say in order to reassure them?
>
> Lord Drayson: "No, we do not."
>
> Q106 Chairman: That is very satisfactory.
>
> Lord Drayson: It is very important the United Kingdom respects technology transfer agreements and keeps secrets secret.
>
> Q107 Chairman: They are convinced by your answer?
>
> Lord Drayson: We have signed the MoU [Memorandum of Understanding], Chairman. (UK House of Commons, 2007a)

In an earlier appearance before the US Senate Armed Services Committee (SASC), Lord Drayson essentially stated that British participation in the JSF comes at a price for the US. While the UK has invested over $2B in this system and is the only "Tier I" partner, the US had arguably not been forthcoming with respect to acquisition of software code needed to maintain and upgrade the JSF. This conduct strikes directly at the "operational sovereignty" that is at the heart of the UK Defence Industrial Strategy. Using typical British understatement combined with

commendable clarity, Lord Drayson outlined how the US could not take even its most important ally for granted. The lengthy excerpt is worth reproducing for its insights into British policy:

> Our aim is to ensure that future generations of UK and US servicemen and women can continue to stand shoulder to shoulder in pursuit of common goals. Increasingly we recognise that this will depend upon access to common technology. With its increasing complexity, and the growing importance of expeditionary fighting power, the necessity to share information and technology between our two great nations both in relation to JSF and more generally is ever more vital.
>
> Whilst I appreciate the concerns of some in the US about the issue of Technology Transfer, the British public expect their Government to equip our Armed Forces with the very best and I am determined to best represent the interests of our national security and our British Service personnel.
>
> The next key milestone in the programme, the signing of the Production, Containment and Follow-On Development MOU [memorandum of understanding] will commit the United Kingdom to the whole life of the JSF program. We must therefore be sure to understand the nature and balance of the obligations between our nations consistent with the principles of the agreements on JSF we have signed to date. Operational sovereignty, the ability to integrate, upgrade, operate and sustain the aircraft as we see fit and without recourse to others is of paramount importance.
>
> Let me state our bottom line. These issues are important to us because they enable us to make the judgement that the aircraft are "fit to fight" and we can send our airmen and women into action in that knowledge. This decision has to be one for the UK, indeed the British Government's responsibility to our Armed Forces, and their families, means that this judgement can only be made by the UK. *If we do not have the information and technology needed to make that decision, then I shall not be able to sign the MOU*. I recognise the consequences that would have on the UK's continuing participation in the programme. (UK Ministry of Defence, 2006, emphasis added)

Jones and Larabee (2005; 2006) have pointed out that streamlining of US export controls is critical to the development of defense collaboration between US and EU nations, as well as multinational cooperative programs such as the JSF. This view has been echoed specifically with respect to the US-UK relationship by Chao and Niblett (2006). Versailles and Mérindol (2006) emphasize the importance for all parties in the US-EU debate to see the “big picture” of international cooperation when engaging in science and technology-related decision-making,

including an understanding of knowledge transfers and networking. Hopefully, both the US and the UK will rise to the occasion and preserve the "special relationship" which is implicitly central to the viability of the Defence Industrial Strategy, now that the MoU has been signed (Bruno, 2007).

7. Understanding the UK Defence Industrial Strategy

Offsets Relabeled? Taken at face value, the *Defence Industrial Strategy* (*DIS*) is intended for a post-offsets regime in defense trade. This may reflect the UK's position as a defense exporter. However, the document is careful to identify areas (core industries) in which there must be UK participation in supplying defense goods. Among other things, this provides for a basis for future negotiations over offsets through industrial participation. While the "offsets" label will likely not appear in future military sales agreements, those who sell to the British MOD will undoubtedly have to tie their proposals to furthering the purposes stated in the *DIS*.

Transaction Cost Economics: One of the major purposes of the *DIS* is protection from risks and costs associated with outsourcing major portions of defense equipment. A Transaction Cost Economics assessment of Britain's defense imports (outsourcing) environment appears in Table 5 below. We use Powell's (2002) stoplight scheme to assess the potential for opportunistic behavior on the part of the supplier (and expected transaction costs *en passant*).

Characteristic	Scope for Opportunistic Behavior	Comments
Asset Specificity	Red	System and system-of-system peculiarities
Complexity	Red	Inherent part of most defense acquisitions
Length of Relationship	Red	Very long, e.g., 40+ years likely for JSF
Frequency of Orders	Red	Continuing need for upgrades and modifications in highly integrated hardware
Operational Significance	Red	Obviously high for major weapon systems

Table 5. Transaction Cost Economics View of UK Defense Imports
(Based on scheme presented in Powell, 2002 and Franck, 2004)

In short, the UK has wide-ranging international interests, and is a military power that consistently hits well above its weight. Also, the UK has no realistic prospects of supporting its defense establishment with a "buy British" approach. Given those considerations, Table 5 reveals a very serious problem for the British defense establishment.

Therefore, the UK's *DIS* is well understood as an approach to solving that problem. The *DIS* is a serious effort along three major axes. First, the Strategy makes a serious effort to define what should, and should not, be imported. Second, "appropriate sovereignty," if attained, greatly mitigates opportunities for suppliers' opportunistic behavior throughout (long) operational services. Third, "operational sovereignty" is directed toward eliminating a holdup—the threat of withholding support for British military equipment while engaged in combat operations.

Corporate Strategy: Shaping the Five Forces. The contemporary defense marketplace poses significant threats to the profitability of the British defense industrial base. The *DIS* reserves certain categories of defense goods and services to defense firms, and insists upon extensive domestic involvement (e.g., ability to modify domestically) and expertise (e.g., in systems engineering). That is, the *DIS*

seeks to protect British defense suppliers from the threat to profits (and viability) posed by rival defense suppliers.

Insistence on the ability to upgrade and modify systems over the lifespan of the system directly addresses the threat of supplier power—directly for the MOD, indirectly for British firms. Also, the rather coy approach to the US special relationship is a way of increasing the power of British firms (e.g., BAE) relative to the US DoD—an effort to translate the UK government's political power to market power for British defense firms.

C. The KC-30 Proposal

In all likelihood, EADS entered the new century with a mixed assessment of future prospects. The consortium's Airbus series had been a clear success, with EADS well positioned as a leading supplier of commercial airliners. However, the ability of European governments to share the risk of developing new airliners was coming under increasing pressure from a number of directions, including US initiatives to take the matter of public subsidies to the World Trade Organization. Moreover, the airliner business is notoriously cyclical in nature, with scant prospect for consistent profitability over extended periods of time.

One logical response to the situation was to diversify the business to other markets. For an aerospace firm like EADS, a logical way to do that was to be more involved in the defense market. With US defense budgets declining proportionately less than Europe's in the 1990s, and growing more after 11 September 2001, it was clear that the United States was where the money was to be had in the defense aerospace market. Moreover, the US was the clear leader of an RMA leading to information-based, network-enabled warfare. In short, Europe was in some danger of becoming a backwater of military technology, and firms confined to European sales were at significant risk of being permanently second-rate. Moreover, European-only suppliers would also have accordingly less favorable export possibilities, and forego any real chance of achieving the economies of scale needed to compete with US defense suppliers. Therefore, Europe-only defense

producers were also in danger of corporate extinction. The EU's 1989 military sales sanctions that applied to China made that problem even more acute.

While entrance into the US defense market was strongly indicated, there were a number of difficulties en route. First, EADS was a foreign firm competing against well-established US suppliers such as Boeing and Lockheed Martin. The American incumbents were strongly positioned with respect to market knowledge, military technology and political connections. Second, strong *Buy-American* sentiment in Congress made competing still more difficult.[48] Further, the less-than-cordial state of relations between the United States and France (with whose government EADS was strongly associated) only compounded this problem.

At the same time, there were a number of opportunities. One of them was the room for more firms in the market. This was due less to the "natural" state of the market (driven by the nature of economies of scale vs. market demand). It was due more to the consolidations associated with the "Last Supper" of 1993[49] having gone perhaps too far (at least in retrospect). Thus, for example, Boeing was one obvious candidate to supply a replacement aerial tanker (KC-45) for the US Air Force. The strongest domestic competition for Boeing for large transport aircraft was McDonnell Douglas, which had merged with (or had been acquired by) Boeing. Thus, Boeing was the only domestic game in town. However, Congress insisted upon competition, for which the only reasonable player available was EADS.

In order to exploit the KC-30 opportunity (and others) in the US markets, EADS had to surmount or finesse the obstacles cited above—especially the *Buy-American* sentiment. EADS's first approach involved an attempt toresemble a US firm. It built, or acquired, production facilities within US borders. There's good reason to believe that at least some of those locations were chosen with a view to influencing Congressional sentiment.

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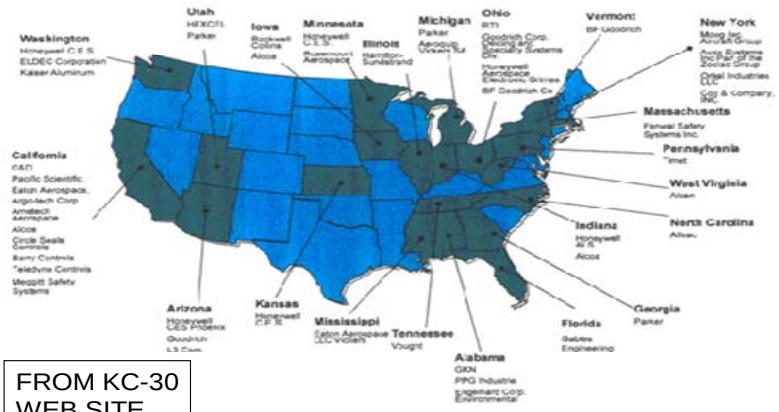
[48] Explicit *Buy-American* provisions were strongly mooted for inclusion in US Defense Authorization bills.
[49] Discussed in more detail in Section 2.

EADS also hired executives with local knowledge of the US defense market, placed in positions directing business operations and lobbying. Finally, EADS mounted a very prominent public relations campaign which touted EADS' new North American identity.

However, with US-French relations continuing to chill and the dispute over governmental risk sharing brewing at the WTO, EADS evidently decided it didn't look enough like an American company. The answer was to shift strategic direction and find a US partner, which is Northrop-Grumman (NG). NG is not only a major aerospace firm but is well established in the US market—with associated local market knowledge and customer connections (within the US government).

The basic goal of EADS' campaign shifted from portraying EADS as an American corporation to portraying the KC-30 as an American aerial tanker. The KC-30 was publicly portrayed as a Northrop-Grumman proposal. Substantial US content was put into the KC-30. The KC-30 proposal to the Air Force (as publicly described) involves a basic ("green") Airbus A330 airframe assembled in Europe, which is then flown to the United States to be converted to an aerial tanker. In short, the KC-30 involves substantial industrial participation within US borders (http://www.northropgrumman.com/kc45/benefits/commitment.html).

KC-30 INDUSTRIAL PARTICIPATION IN US



FROM KC-30 WEB SITE

1

Figure 3. Depiction of EADS Direct Offset Offer
(Northrop Grumman, 2007)

1. Understanding the KC-30 Proposal

Stealthy Offsets. Crafting the KC-30 proposal involved offering offsets to a prospective customer which had avowed its opposition to offsets (as discussed in Section 3B above). Direct offsets in the KC-30 proposal, accordingly, were, by necessity, integral to the proposal to the Air Force, and definitely not a matter for subsequent negotiation. Establishing EADS's production capacity in the United States was part of the answer—offering American content (jobs) and substantial direct offsets (industrial participation). In particular, EADS' recent proposal to shift A330 production to the US is part of a tacit (and largely unacknowledged) process of bargaining over the offset package.

Corporate Strategy: While highly successful, EADS (including its Airbus venture) also had major problems, particularly with its competitive position relative to Boeing. Two of its major advantages were: (a) the favorable Euro/US Dollar exchange rates, and (b) the willingness of European governments to assume risks of developing new products and help in other ways. However, it seemed unlikely that

the Euro would trade at less than one dollar indefinitely. Also, the governmental arrangements were coming under increased pressure through complaints filed with the World Trade Organization. Moreover, the commercial market for Airbus products was highly cyclical (and about to turn down). While Boeing was subject to the same cyclical air transport market, it had a well-established and profitable defense business—primarily with the US government. EADS, on the other hand, was stuck in the much less lucrative European defense market. In short, the competitive correlation of forces of EADS vs. Boeing was not terribly favorable for the long run.

A Five-Forces assessment of the threats to EADS profits around 2000 would look something like Table 6 on the following page. In this context, the EADS strategy for entering the North American defense market is readily explainable using the corporate strategy paradigms discussed in Section 2D above. EADS found itself with a fairly secure market niche in commercial air transports. However, the business model of governmental risk-sharing was in some jeopardy. Likewise, air transport orders were highly variable— making meaningful diversification of the product line an important consideration.

FORCE	THREAT TO PROFITS	COMMENTS
Internal Rivalry	Moderate to High	Excess capacity at low part of cycle; competitive disadvantages with respect to Boeing.
Entry	Low	Economies of Scale.
Substitutes & Complements	Low	Few substitutes for large air transports; many complements.
Supplier Power	Low	Many suppliers; few buyers
Buyer Power	Varies Widely	Buyers can drive hard bargains at low points in demand cycle.

Table 6. A Five-forces Assessment of EADS/Airbus, circa 2000

To protect their profits, firms like EADS can take some combination of the three basic approaches discussed above: cost and performance advantages, a new market niche, and a change in the characteristics of the current environment. Of these, finding a new market niche seemed most promising. The cost advantage afforded by the Euro-dollar exchange rate could easily change. Moreover, arrangements with EU governments came with a price—significant constraints on national shares of overall production. Thus, a cost advantage over Boeing or other competitors would be difficult to maintain, even if it were achieved. Since all major players in the defense and aerospace industries had access to the same technologies as EADS, there was no obvious way to offer significant performance advantage. Moreover, since interoperability with US forces had become an important consideration in source selections, EADS would have a disadvantage relative to its American competitors in aerospace and defense markets (perhaps permanently).

The third approach, changing the local environment, was not terribly promising. EADS and Airbus already had a relatively favorable environment for profitability with the European Union. The obvious way to improve that environment would be a large-scale EU-based emulation response to the US RMA. The investments associated with such an effort would be significant, and not likely to be sustainable within the EU's current political environment.

In short, EADS proposed to protect its profitability by diversifying into the North American defense market. Taken within the context of the Five Forces model, this can be construed as either seeking a new (less threatening) market niche, or, more generally, changing Porter's Five Forces within its environment. However, there were significant barriers to entry to the new market niche—a defense-sector analogy to brand loyalty being perhaps the most important. An analysis of the EADS threat to enter the American defense market (from a Five Forces perspective) is offered in Table 7 below.

Market Characteristics	EADS situation	Comments
Economies of Scale	Favorable	Large, established defense supplier.
Reputation, brand loyalty, protection of incumbents	Highly unfavorable	Testy US-French relations; strong *Buy-American* sentiment.
Access to distribution channels, raw materials, technology, good locations	Moderately Favorable	Well-established enterprise. Interoperability issues.
Marketing advantages for incumbents	Highly unfavorable	US firms have much better access to the US government.
Expected retaliation	Favorable	EADS well-protected in Europe.

Table 7. A (Five-forces) Assessment of EADS's Threat to Enter the US Defense Market, circa 2000

A direct approach was to make EADS more of an American firm by acquiring assets in the United States.[50] EADS intensified the campaign through its strategic alliance with Northrop-Grumman, thus providing an American name along with American content to the KC-30 proposal. Moreover, Northrop-Grumman brought a number of other assets to the partnership, including its connections with the US Government and its experience in defense systems that must be interoperable with other parts of the US-defined Reconnaissance-Strike Complex (RUK).

A well-structured KC-30 proposal also exploited an increase in firm power (relative to buyer's). In the case of the KC-30, there was only one credible US supplier (Boeing). The competition imperative[51] required at least one other proposal. EADS was thus placed in a relatively powerful position, and was thus given a significant opportunity to overcome barriers to entry to the US defense market. In

[50] The recent depreciation of the dollar relative to the Euro may accelerate this trend. Radio France interview with Louis Gallois (EADS CEO), 3 December 2007, cited in *DefenseNews*, 10 December 2007, p. 36.

[51] This view is associated most strongly with Senator John McCain.

these terms, the KC-30 proposal is a major part of a well-crafted corporate strategy to protect EADS' corporate profitability by becoming a major US defense supplier.

Transaction Cost Economics (TCE): While the KC-30 proposal has successfully overcome or finessed a number of barriers to entry in the North American market, it still has problems. Indeed, some concerns remain, and are readily perceived from a TCE perspective. The EADS-Northrop Grumman team still needs to offer assurance about risks associated with outsourcing.

First, aerial refueling is clearly a core competency of the US Air Force (both tankers and receivers). In that context, the Chief of Staff of the Air Force assigned first priority to aerial tankers within the service's acquisition programs. Therefore, it might be regarded as something that shouldn't be acquired outside national borders. That said, EADS' partnership with Northrop Grumman addresses the national identity problem. In that context, configuring the KC-30 for aerial refueling within US borders may well carry the day. The offer to assemble A330 freighters in the US adds weight to the case.

Second, and more serious, is fear of some sort of "holdup." In the context of foreign military sales, this would be the source country denying system support to the purchasing country—probably because of military operations encountering the source country's disapproval.[52] For a military capability as fundamental as aerial refueling, this would not be a trivial risk, and the sometimes testy state of US-French relations adds emphasis to this concern. This could have been (and might well still be) a thorny issue for the EADS-Northrop Grumman team – perhaps in Congressional deliberations.

[52] Denial of such support for US military operations was a major part of the case for Rep. Hunter's *Buy American* proposal.

V. By Way of Conclusions

As stated previously, this report was motivated by a desire to better understand developments taking place in defense industries focused on the United States and the European Community. We have discussed the current state of the trans-Atlantic defense market and its many complexities. We have also presented models that might be of use in understanding the nature and implications of ongoing developments.

We found that our models were not as neatly separable as Graham Allison's. In particular, outsourcing relationships and many offset agreements involve extended relationships with mutual reciprocity. Hence, a number of relationship-management issues that are associated with Transaction Cost Economic literature were also present in the execution of offset agreements, as was evident in Section 3.

However, we do conclude, at least tentatively, that the models presented are useful for understanding defense industrial developments and are largely complementary. It's reasonable to assert that all three models have significant explanatory power for the cases we've discussed.

Our choice of cases (the JSF, the UK's *Defence Industrial Strategy*, and the KC-30) proved to have both advantages and disadvantages as subjects for research. Since all three cases are still ongoing, the facts on the ground changed fairly regularly. Thus, for example, execution of the UK's *Defence Industrial Strategy* has been called into some question due to recent reduction in the Ministry of Defence budget and the departure of Lord Drayson. Regardless of these difficulties, we believe that the *Strategy* is a serious effort to resolve a number of systemic tensions and dilemmas that reside in global defense markets.

Likewise, the EADS (and Northrop Grumman) offer to assemble Airbus A330 freighters in the Alabama facility that would perform KC-30 tanker conversions was an interesting and thought-provoking development.

The three models, assessed against our three cases turned out to be complementary rather than competing. The various perspectives available for all three cases are certainly not fully consistent, but neither are they conflicting. All three models have demonstrated significant explanatory power. We conclude that the offsets paradigm is the most useful for explaining the course of the Joint Strike Fighter, although not in the standard sense. The JSF program appears to be structured for the purpose of avoiding the strictures of offsets by bringing in the most likely customers as risk-sharing partners. (Our interviews cast some doubt on whether that vision will be realized in any significant sense.)

Similarly, the corporate strategy perspective sheds the most light on the KC-30 case. What seems an inescapable conclusion is that the EADS strategy for becoming a major player in the North American defense market was well-crafted and is being well-executed. We do not contend that our three models, even taken together, are the only useful perspectives for the KC-30 case. For example, it seems likely that part of the motivation for EADS's A330 freighter offer is a desire to situate production in the realm of the (currently cheap) dollar.

Finally, the TCE model seems best for understanding the underlying logic of the UK *Defence Industrial Strategy*. Standard TCE analysis of imported (outsourced) defense systems such as the JSF indicates significant scope for opportunistic behavior on the part of foreign suppliers, as was demonstrated above.

Thus, our hypothesis regarding the usefulness of multiple models to understand and explain the international defense marketplace is indeed supported by our cases.

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