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U.S. MILITARY AIRCRAFT FOR SALE:

CRAFTING AN F-22 EXPORT POLICY

BY

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About the Author

Lt Col Matthew H. Molloy was commissioned through the Reserve Officer Training Corps, University of Colorado, Boulder, in 1987. Graduating from Euro-NATO Joint Jet Pilot Training in 1989, he went on to fly F-15s at Holloman Air Force Base, New Mexico; Keflavik Naval Air Station, Iceland; and Tyndall Air Force Base, Florida. Lt Col Molloy is a graduate of the USAF Weapons School and is a senior pilot with 2200 flying hours. He has his bachelor's degree in Aerospace Engineering from the University of Colorado, a master's degree in Aerospace Science Technology from Embry-Riddle Air University, a master's degree in Military Operational Art and Science from the USAF Air Command and Staff College. In July 2000, Lt Col Molloy was assigned to the 18th Wing, Kadena Air Base, Japan, as the Chief of Wing Safety. Lt Col Molloy is married to the former Kathleen Wanebo, and they have four daughters: Rachel, Rebekah, Hannah, and Sarah.

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Abstract

America has a long tradition of cooperation through military assistance with other nations that share common values and defense interests. Arms transfers are an important element of this cooperation. Moreover, the United States has found arms transfers, especially military fighter aircraft, a valuable instrument of foreign and domestic policy. Soon, the U.S. Air Force will receive the world's most advanced and capable fighter, the F-22. Undoubtedly, an aircraft such as this will be attractive to foreign purchasers.

The purpose of this paper is twofold. First, it offers a general framework for junior and senior decision makers to use as a touchstone when considering the transfer of advanced air technologies. Second, it specifically addresses the exportability issues associated with the F-22—which other countries have already begun to express interest in acquiring. With this in mind, the paper specifically focuses on whether or not the U.S. should consider risking the potential for migration of critical technologies such as stealth by exporting the F-22. If the aircraft is to be exported, the study further investigates who might be an eligible buyer and what factors must be given weight when making such a decision.

Originally, the intent of this paper was simply to investigate the exportability of the F-22. To answer this question, however, an air-export framework needed to exist in order to provide a structure for thinking about the issues associated with transferring exclusive technologies. A framework of this sort does not exist. Therefore, one was created—in a rather didactic manner—where issues germane to the F-22 naturally fed the policy framework and vice versa. By doing so, the scope of the thesis expanded to include a logical method for considering any future high-tech air export such as the Joint Strike Fighter (JSF).

The paper is organized into four basic sections. The first section provides the background behind aircraft transfers and looks into the byzantine world of U.S. air-export

policy. Next, the existing export laws, acts, and standing policies that affect aircraft transfers are described along with the current export process that takes place in Washington. With this as background, the discussion then shifts to assessing the advanced technologies and capabilities of the F-22, emphasizing those qualities that are unique compared to today's front-line fighters. These attributes—and their exploitability—will be an essential element of any future U.S. air-export policy. Finally, a summary draws conclusions about exporting aircraft with exclusive features such as the F-22 and JSF. Since each export decision has its own unique set of international and domestic elements for consideration—which must be individually weighed against the politics of the moment—a prescriptive model cannot adequately be constructed. However, a general framework in which to make a rational transfer decision is introduced. Applied to the F-22, this framework yields insights regarding its exportability. First, it indicates that a limited F-22 export to America's closest allies—Australia, Great Britain, and Canada—is reasonable. Second, an expanded export to other close allies may also be within the realm of possibility, but will ultimately depend on the level of technology protection built into the export variant.

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Introduction

Background

America has a long tradition of cooperation through military assistance with other nations that share common values and defense interests. Arms transfers are an important element of this cooperation. Moreover, the United States has found arms transfers, especially military fighter aircraft, a valuable instrument of foreign and domestic policy. On the other end, the recipients perceive acquisition of aircraft and co-production contracts as an important aspect of their national defense, international prestige, and technological and industrial advancement programs.

The modern era of arms transfers began in the early 1940s with President Roosevelt's "Destroyers for Bases Deal" whereby the United Kingdom would receive 50 aged warships. The U.S. Congress subsequently passed the Lend-Lease Act in 1941 authorizing the president to sell, lend, lease, and transfer war materiel as he saw fit. After World War II, arms transfers continued to mature as an instrument of foreign policy. They were used first as a means of thwarting communist expansion, then developed into a more complex form of policy—ranging from a tool to preserve the defense technological and industrial base (DTIB) to a diplomatic means of gaining influence and leverage over other governments.

Significance

As the U.S. arms transfer policy has evolved over time, so has the relative level of sophistication regarding exports. Initially, the U.S. generally transferred only older generation-aircraft—aircraft such as the F-104 would migrate to NATO as the U.S. fleet

upgraded to more advanced and capable fighters. By the mid-70s, the U.S. was willing to produce a front-line fighter that not only addressed the needs of its own Air Force but could also be exported to other countries. Countries received an export variant of the F-16, which was modified with technology protection measures and reduced capabilities. The Air Force's premier air superiority fighter, the F-15, has also been made available for export under the same protection measures.

In 1999, the U.S. made another significant departure in its air-export policy by agreeing to release technology and capabilities to foreign purchasers more advanced than the resident capabilities of its own front-line force. The aging U.S. fleet, which has been slow to modernize, has suddenly found itself lagging behind the level of technology available on the international market. In an effort to maintain and advance the DTIB and compete with foreign products such as the Rafale and Eurofighter, U.S. decision makers have found it necessary to develop and transfer highly sophisticated and advanced variants of U.S. front-line fighters. Though startling to some, these transfers may create opportunities in arenas of both military affairs and international relations.

Research Question

Soon the U.S. Air Force will receive the world's most advanced fighter, the F-22. This weapon system will once again propel the U.S. fighter force in front of its competitors, peers, and adversaries. As the United States Air Force transitions into the F-22, it will move from advanced technology into the realm of the exclusive. Within the next decade, there will be no other fighter that can match the F-22 in stealth, sustained speed, maneuverability, and level of sensor integration and fusion.

An aircraft such as this, which is touted as being able to penetrate the most advanced air defense systems via stealth, agility, and electronic countermeasures, with the ability to "target and destroy enemy aircraft before they are aware of its presence," will undoubtedly be attractive to foreign purchasers who can afford it (and those who cannot). Indeed, would the U.S. consider risking air superiority and the potential for migration of stealth technology by exporting such a machine? If so, who would be an eligible buyer and what factors must be given weight in that decision?

These are the questions this paper will attempt to answer. The approach will be "wide-to-narrow," starting with a general description of the domestic and international political forces at work shaping a high-tech air-export decision. The export control and oversight process in which an F-22 export decision would be entertained will then be discussed. Following this, an analysis of the exclusive attributes of the F-22 will better illuminate what is on the table should such an aircraft be exported. Risk mitigation through technology protection measures taken by the government and the manufacturer will also be discussed. From this, a rational recommendation for or against an F-22 export can be made.

This general-to-specific approach provides a basic framework for examining other high-tech air-exports. Hence, the research question asked (and answered) in this discussion has relevance beyond the scope of the F-22—offering a useful methodology for decision makers to approach other high-tech air exports, such as the Joint Strike Fighter (JSF), Advanced Medium Range Air-to-Air Missile (AMRAAM), and the like.

Overview

A firm grasp of the problem requires a description of the domestic and diplomatic elements that influence an air export policy. It will be shown that a robust and carefully crafted aircraft export policy can be a positive instrument of U.S. foreign diplomacy—enhancing regional stability and forging stronger ties between the U.S. and other nations. Foreign military sales (FMS) also provide the U.S. with a diplomatic tool to gain *access* and *influence* within countries. Proliferating U.S. aircraft to friendly countries also enhances interoperability and coalition warfare, providing a means to better integrate allied air forces. The political symbolism of an arms transfer is not insignificant—mutual trust and recognition of another country's sovereignty and international status may be established through an aircraft transfer. Foreign military sales (FMS) also have positive effects on the defense technological and industrial base (DTIB), providing a rich source of capital, preserving domestic production lines, and creating opportunities for significant technological advances. Additionally, fighter exports can generate heavy "offset" demands by purchasing countries. Offsets are industrial compensation practices that oblige the U.S. to buy into the purchasing country's economy as a condition of the export

deal. Offsets can cost the U.S. in lost jobs, technology migration, price inflation, and in future export markets.

The components of an air-export policy as well as the export approval process warrant exploration. First, the existing export laws, acts, standing policies, and their amendments that affect aircraft exports will be investigated, to include a brief history and description of these laws, acts, etc. Second, the export process will be described in general. Finally, we must address the "labyrinth of control" that is in place for handling air-export requests. This system insures that all the ramifications of a specific air-export are adequately addressed and that appropriate safeguards are established to protect U.S. interests.

An assessment of the F-22 reveals advanced technologies, qualities, and capabilities that are unique compared to today's front-line fighters. Such differences may affect future U.S. air-export policies. By addressing the advanced technology concerns associated with export of the F-22, a solid framework can be constructed for answering similar questions down the road with JSF. Since the JSF *is intended to be exported*, thinking about these issues now—by considering a limited F-22 export—may prevent unintended technology proliferation later. It will be shown that, indeed, the F-22 includes several exclusive technologies, qualities, and capabilities that set it apart from any other fighter being flown today. Its exclusive attributes can be categorized into the following areas: *stealth, sustained speed, agility, and integrated avionics and sensor fusion.*

A summary will then "put it all together" and draw conclusions about exporting future high-tech aircraft such as the F-22 based on the evidence presented in the previous chapters. Since each export decision has its own unique set of elements for consideration—which are individually weighted by the politics of the moment—a "prescriptive" model cannot adequately be built. However, a list of important air-export decision elements and a framework in which to make a rational transfer decision will be introduced. Applied to the F-22, this framework will yield insight regarding its export.

Chapter 2

The Political Environment of an Air-Export Decision

In crafting an export policy for advanced fighters such as the F-22 and JSF, it is important to understand the domestic and diplomatic elements that are at work influencing U.S. policymakers' decisions. From their perspective, air-exports represent a two-sided coin. On one side, there are domestic factors—these include the preservation (and advancement) of the DTIB, the security of U.S. jobs, and the protection of technology from foreign exploitation. On the other side are international relations factors. These address regional stability and security issues, political and diplomatic relations, and military compatibility and interoperability issues.

The purpose of this chapter is to explore the domestic and international elements of high-tech exports. It will be shown that a robust and carefully crafted aircraft export policy has many benefits, including international stability. The chapter will first describe the benefits of such a policy to the defense technological and industrial base (DTIB) and then to the international relations arena. Foreign military sales provide a rich source of capital, preserve U.S. production lines, and create opportunities for significant technological advances. However, there can be a downside to exporting U.S. front-line fighters: they can be used against us. Additionally, fighter exports can generate heavy "offset" demands by purchasing countries. Offsets are industrial compensation practices that oblige the U.S. defense contractors to buy into the purchasing country's economy as a condition of the export deal. In some cases, offsets can cost the U.S. in lost jobs, technology migration, price inflation, and future export markets.

Domestic Factors of an Air Export Policy

Most would agree that the future security of the U.S. is contingent upon a strong DTIB—one that holds a technological edge over any potential foe. Yet, this must be done during a time when weapons procurement budgets have been cut by over 50 percent from their peak during the 1980s.[1] More than likely, small defense budgets are here to stay. Therefore, the defense industry must survive by alternate methods and means. Dr. Jacques S. Gansler, in his book *Defense Conversion: Transforming the Arsenal of Democracy*, offers three criteria which the defense industrial base must satisfy in order to maintain itself on a tight budget. First, it must provide effective national security, despite receiving far fewer dollars. Second, it must become efficient, responsive, and innovative. This can include restructuring, diversifying, and pursuing dual-use technologies. Finally, the DTIB must better use its research and development funds to generate more domestic economic growth and industrial competitiveness—this may be done by better integrating civil/military industrial and technological production.[2]

Dr. Gansler further stresses that the DTIB "does not need to rely on worldwide proliferation of weapons to create revenue."[3] He goes on to state, "both Congress and the White House see foreign arms sales as creating defense jobs—and, therefore, votes—even if the sales have obviously destabilizing security implications."[4] On the last point, however, he fails to consider several positive aspects of foreign military sales (FMS). In an Air War College thesis, Lieutenant Colonel Michael Beard describes the positive aspects of FMS as a means of providing *access* and *influence* into various countries and regions.[5] Additionally, such sales provide an opportunity for the U.S. to enhance security interests, foster regional stability, and promote international cooperation.

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[1] Jacques S. Gansler, *Defense Conversion: Transforming the Arsenal of Democracy* (Cambridge: MIT Press, 1995), 4.
[2] Ibid., 16-17.
[3] Ibid., 17.
[4] Ibid., 16.
[5] Lt Col Michael N. Beard, "United States Foreign Military Sales Strategy: Coalition Building or Protecting the Defense Industrial Base," Research Report (Maxwell AFB, Ala.: Air War College, March 1995), 1. Lt Col Beard worked for the Deputy Under Secretary of the Air Force, International Affairs from 1992-1994. There, he served as Chief, International Aircraft Programs responsible for all Air Force foreign military sales.

Aircraft and their associated technologies are the single largest positive trade area of any U.S. business.[6] The Clinton Administration recognized this, and in 1995 loosened arms export controls. Part of the decision process contained in this policy considers, "the impact [on] U.S. industry and the defense-industrial base."[7] As a result of this policy, the United Arab Emirates (UAE) has been granted their request to purchase 80 F-16 fighters packed with more advanced technology than those in the current U.S. inventory. These aircraft have a range and avionics capability (among other things) that are superior to U.S. F-16s.[8] On the surface, such a transaction seems ludicrous in terms of maintaining technological security and a combat capability advantage. However, the Air Force's International Affairs and Weapons Division (SAF/IARW) contends there are anti-tamper controls to reduce the risk of this technology being used for unintended purposes.[9] Controls can be placed on the aircraft's electronic warfare (EW) and radar system that prevent the buyer from accessing the "source code." Also, the Air Force expects to have its trump cards, the F-22 and the JSF, online to counter these aircraft in the event they become a threat in the distant future. SAF/IARW explains that "there is an advantage to knowing exactly what you're up against," should a friend turn foe. Additionally, they contend there is some degree of control over countries relying on U.S. produced aircraft.

The UAE sale also highlights some of the negative aspects of exporting air technology. In order to compete with countries such as Russia and France—who export their top-of-the-line fighters—the U.S. must offer something *better*. Had the U.S. not sold F-16s to the UAE they would have most certainly purchased the French Rafale. Therefore, there are advantages to high-tech sales that displace competition such as the Rafale—an aircraft whose capabilities are not fully known—and replace it with a system whose capabilities and limitations are known and quantifiable. Along with this also comes better interoperability with U.S. systems—yet another advantage to capturing the friendly country market.

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[6] Gansler, 48.
[7] Michael McCurry, *US Conventional Arms Transfer Policy* (US Department of State Dispatch, Vol. 6, Issue 9, 2 February 1995), np.
[8] Justin Brown, "Arms Sales: Exporting US Military Edge?" *Christian Science Monitor*, 2 December 1999.
[9] Major Keith A. Seaman, SAF/IAW, Washington D.C., interviewed by author, 8 December 1999.

British Air Vice Marshal Tony Mason in his book, *Air Power: A Centennial Appraisal*, also comments on these dynamics and the British fear of U.S. domination of the armaments market. He states that the fear is "well founded" and goes on to describe a letter to the U.S. State Department from a senior executive with McDonnell Douglas at the time of the negotiations in 1992 regarding an F-15 sale to Saudi Arabia. According to Mason, the writer of this letter expressed concern lest Saudi Arabia should buy EFA (EF-2000) instead of the F-15 because, "the Saudis would be able to configure their EFAs to their own specification, and the capabilities of those aircraft could be significantly enhance in the future without U.S. knowledge, consent or control." On the other hand, the McDonnell Douglas executive muses how,

> the sale of the F-15 to Saudi Arabia would significantly impair the ability of Europe's aircraft industry to develop a next generation fighter that would be sold freely in the Middle East. As a result, this scenario would greatly improve U.S. control over military aircraft operated by other countries and ultimately enhance U.S. competitiveness in the European defense market . . . The serious weakening or even elimination of the foreign competition helps the U.S. to retain its lead in a strategically vital industry, and perhaps more significantly could empower the U.S. to act unilaterally in the future to effectively control the supply of arms to other nations.[10]

Concerning the more recent UAE deal, profit appears to be far more important than the desire to exert control over a foreign export. As it stands, the sale is worth $6.4 billion to Lockheed Martin. According to SAF/IARW, capturing this investment is also critical for the U.S. to stay on top in air technology and also allows it access to technological improvements of its own fighter fleet (at the foreign customer's expense). This is primarily because new purchases take advantage of production enhancements and manufacturing change proposals, which allow current-day technologies to be infused into the aircraft. In fact, the UAE's choice of the 32,000 lb.-thrust F110-GE-132 engine has provided the U.S. Air Force with an opportunity to reap substantial life-cycle savings in its existing F110 fleet. Engine nozzle cooling techniques and a new fan design

[10] Tony Mason, *Air Power: A Centennial Appraisal*, (Washington: Brassey's, 1994), 248.

incorporated in the F110-132 can be retrofitted in the USAF F-16 fleet and could potentially save the Air Force $133 million over a 20-year period.[11]

The UAE deal is especially lucrative for American technological progress as $2 billion dollars has been ear marked for research and development (R&D). The sale represents the first transaction in which a foreign country would actually pay to develop and receive significant *new technology*—"Block 60" F-16s. The most advanced F-16s in the U.S. inventory are Block 50/52 versions. The UAE was also able to play Lockheed Martin against other international aircraft manufacturers, pressuring the U.S. to share more advanced technology than it would have liked.[12]

According to sources in the Pentagon, the two primary items of concern with the Bock 60 release were the active electronically scanned array (AESA) radar and the electronic warfare suite. These two systems will be far superior to those found on U.S. F-16s. In fact, some officials in the Pentagon likened the capability of the Block 60's EW system to that of a "mini Rivet Joint" in terms of electronic emissions monitoring and collection. A significant portion of the $2 billion R&D money will be put toward the development of these two systems.

Foreign sales have also helped to keep U.S. fighter production lines open. Since 1995, the F-15, F-16, Patriot, Apache, and Blackhawk have been sold almost entirely to foreign countries.[13] Preservation of these production lines has allowed the U.S. to purchase replacement fighters that otherwise would not have been available. These purchases have been critical to maintaining the U.S. force structure as the F-22 continues to be delayed and plagued with on- and off-again funding. In fact, the Air Force currently is urging Congress to fund the purchase of more F-16s. Shortages of this aircraft are projected within the next few years—approximately 50 to 120 F-16s will be needed.[14] The option to buy more of these aircraft would not have been possible had FMS not sustained the production lines (at one point, the U.S. planned to make its final F-16

[11] Stanley W. Kandebo, "UAE's Engine Choice Offers USAF Potential Cost Savings" *Aviation Week and Space Technology* 152, no. 16 (17 April 2000): 39.
[12] Brown.
[13] Major William J. DelGrego, "The Diffusion of Military Technologies to Foreign Nations," Research Report (Maxwell AFB, Ala.: School of Advanced Airpower Studies, March 1996), 33.
[14] Steven Watkins, "Air Force Seeks More F-16s, 15s" *Air Force Times,* 18 September 1995.

acquisition in 1997). Should the U.S. elect to purchase Block 60 F-16s in the future, it will have access to the new technology *without* incurring any major R&D costs.

Arguably, this may stand as one reason to export front-line equipment over older-generation equipment as had been America's general practice of the past. Prior to the Gulf War, the U.S. was more inclined to offer its older and out-dated fighters through grant transfers as provided by the Excess Defense Articles (EDA) program under the Foreign Assistance Act. Section 502A of the Foreign Assistance Act directs that excess defense articles "be provided whenever possible rather than providing such articles by the procurement of new items." Examples of these transfers include F-4s, C-130s and F-5s to Turkey, Egypt, Israel, and Greece; F-111Gs to Australia; and OV-10s to Colombia and Venezuela.[15] This, however, did not exclude the U.S. from also selling modern fighters and, indeed, front-line fighters were transferred to NATO and other countries such as Iran on a selective basis, but this was the exception more than the rule.

After the Gulf War, this transfer policy was found lacking for several reasons (if not for the simple reason that the U.S. has already flushed out most of the older aircraft from its inventory). First, coalition partners using out-dated U.S. equipment during the war introduced some significant incompatibilities under joint employment—airborne communication problems existed with their lack of secure and anti-jam radio equipment. Many of the older aircraft were also incapable of dropping precision munitions or launching advanced air-to-air missiles. Second, older equipment required unique parts and support equipment, which posed problems for logistical support and interoperability. Finally, Washington recognized that with the post-Cold War draw down, the DTIB had to still somehow be maintained.

To help mitigate the last issue, in 1993, Congress amended the law governing EDA transfers to require the President to "first consider the effects of the transfer of the excess defense articles on the national technological and industrial base, particularly the extent, if any, to which the transfer reduces the opportunities of entities in the national technology and industrial base to sell new equipment to the country or countries to which the excess defense articles are transferred." This, along with the recognition of foreign

competition, interoperability and compatibility issues, and the lack of anything else suitable to provide has brought about a shift toward offering allies and friends modern systems. More than just selling front-line fighters, the U.S. seems to now be comfortable releasing them with technology more advanced than what is found in the U.S. inventory.

Like the UAE deal, the 1995 Korean purchase of 120 Block 52 F-16s represents an export where the aircraft have several facets of technological superiority over vast majority of the U.S. F-16 fleet. Called the Korean Fighter Program, its aircraft are equipped with Low Altitude Navigation and Targeting Infra-Red Night (LANTIRN), which only limited number of U.S. F-16s have. The Korean aircraft also have an internal Airborne Self-Protection Jammer (ASPJ), which frees all the external weapons stations for carrying weapons—all U.S. F-16s must carry externally mounted electronic countermeasures pods (limiting range, maneuverability and weapons). The Korean jets are equipped the most powerful engine available—the F100-PW-229, only U.S. Block 50 F-16s have this motor. Not only are the Koreans able to carry all the ordnance that the U.S. F-16 carries, but also may deliver the Harpoon anti-ship missiles and Standoff Land Attack Missiles (SLAM)—currently, U.S. F-16s do not carry these. Finally, these jets are all outfitted with GPS and an identification friend or foe (IFF) systems—few U.S. F-16s have any IFF capability, which can be a major limiting factor when employing air-to-air missiles beyond visual range.[16] The Koreans are building most of these aircraft. The first few were built at Lockheed Martin Tactical Aircraft Systems (LMTAS), and the remainder are being produced under license at Samsung Aerospace in Sachon, Korea (production deliveries are expected through 2009).

International-Relations Factors of an Air Export Policy

Political and Diplomatic Elements

Arms transfer has been an instrument of U.S. foreign policy since the Lend-Lease Act of 1941, when the U.S. supplied arms to Great Britain and the Soviet Union.

[15] Beard, 13. The original Australian purchase of the F-111C represented state-of-the-art technology. Chapter 5 will discuss the unique and close relationship the US enjoys with Australia.
[16] Ibid., 3-4.

William DelGrego notes that since the U.S. began transferring arms its sales have been in line with its geo-political regional interests.[17] "Focus shifts" also may occur, based on the changing interests of U.S. policymakers. He identifies four distinct periods—or foci—regarding arms transfer policy. These are: NATO Rearmament; the Vietnam Era; the Middle East Era; and the Post-Cold War Period. During any specific period, the preponderance of arms transfers is commensurate with the region of interest. Today, in the Post-Cold War era, the U.S. has a two-MRC (major regional contingency) strategy that focuses on the Middle East area and Korea. Not surprisingly, the majority of arms deliveries have been to these areas. The Clinton Administration has reinforced this strategy by stating that, " . . . sales of conventional arms are a legitimate instrument of U.S. foreign policy deserving U.S. government support when they help friends and allies deter aggression, promote regional stability, and increase interoperability of U.S. and allied forces."[18]

Recent diplomatic initiatives regarding Taiwan also highlight how military exports may serve as a visible form of commitment to a given region or country. In November 1999, the House International Relations Committee drafted a bill seeking to bolster Taiwanese defensive capabilities through the sale of advanced U.S. weapons. This bill would permit the sale of Aegis early warning systems (the foundation for naval air defense and ballistic missile defense systems) and high-tech AMRAAM air-to-air missiles. Later, the Clinton Administration would deny the destroyer transfer but approved a smaller package including long-range radars designed to detect missile launches.[19] Just as important, these exports are used to shape U.S.-China foreign policy and serve as *a form of deterrent diplomacy*—signaling that the U.S. intends to stand firmly for Taiwan.

FMS also serve as a diplomatic tool to gain *access, leverage, and influence* within countries or regions. For example, the sale of F-16s to the UAE will strengthen the U.S. foothold in the Persian Gulf region. "It will give us more access to airfields in the

[17] DelGrego, 7-13.
[18] GAO, *Military Exports: A Comparison of Government Support in the United States and Three Major Competitors*, Report to Congress, GAO/NSIAD-95-86, May 1995, 29.
[19] No Sale for Taiwan Vessels," *Montgomery Advertiser*, 18 April 2000, sec. A.

region."[20] Such initiatives have been used extensively (and rather successfully) with Saudi Arabia. FMS and transfers also increase U.S. diplomatic influence: countries using U.S. equipment must "play by the rules" or risk being cut-off from the logistical, technical, maintenance, and training support they need for managing the system.[21]

High-tech arms transfers may also aim to limit the proliferation of nuclear weapons. Diplomats believe that by offering advanced weapons, countries such as Pakistan might be dissuaded from acquiring nuclear capabilities. However, this "carrot" offered to Pakistan failed and, in 1990, an already-approved (and paid for) transaction was halted. Replacing the carrot with a stick, the U.S. imposed sanctions against Pakistan under the Pressler Amendment, and 28 brand-new F-16s were flown directly from the Fort Worth factory to the "bone yard" at Davis Monthan Air Force Base for storage.[22] In December 1998, President Clinton agreed the U.S. would repay Pakistan in cash and benefits the $463.7 million they had spent on the aircraft deal.[23]

During the Cold War, aircraft transfers have also been used as an instrument in the global competition with the Soviet Union. U.S. policymakers have relied (not always successfully) on arms transfers and the associated support and training agreements to limit Soviet influence within a region and thereby strengthen pro-Western sentiment. In fact, in areas where the U.S. had attempted to employ a policy of restraint—namely, in Latin America and Africa—France, the United Kingdom, Israel, or the Soviet Union proved all too willing to meet the regional demand for arms.

***Today, aircraft transfers still reflect global competition* but for *different motivation*s and with *different prime competitors*.** As previously described, the preservation of the DTIB and its advancement of technology, free-market profit incentives, and the notion of limiting the threat to known and quantifiable (hence, defendable) U.S. systems have now become the prime motivators for exporting. As for competitors, Russia is still significant but France has since pushed to the forefront with its global sales of air defense systems and the Mirage 2000 (France was the chief competitor

[20] Brown.
[21] Beard, 5.
[22] Major Forest B. Wortman, "Equipping Foreign Air Forces: How Far Should the US Government Go?," Research Report (Maxwell AFB, Ala.: Air Command and Staff College, April 1999), 12.
[23] Ibid., 12.

to the U.S.-UAE F-16 sale). In 1998, the leaders of arms deliveries to developing nations were as follows:

Rank	Supplier	Deliveries Value (in millions, 1998)[24]
1	U.S.	$7,805
2	France	$6,200
3	UK	$4,800
4	Russia	$1,700
5	Germany	$500

Regional export policies may also function as a symbol for diplomatic good will and a vehicle for conveying trust, sovereignty, and mutual respect. Historically the U.S. has used Latin America as an "arms policy dumping ground." [25] Paternalism and indifference to this region have limited air exports to lower-technology fighters such as the A-4, the F-5, and the A-37. The only exception to this policy was the 1982 sale of F-16s to Venezuela by the Reagan Administration. This policy of general restraint toward Latin America has caused diplomatic stress in that region.

For the most part, Latin American arms restraint has rested on the 1977 Presidential Directive 13 (PD-13), which blocked the sale of advanced military technology to this region. PD-13 required that arms transfers be directly linked to furthering U.S. security interests and placed a heavy emphasis on human rights records for the recipient country (Chapter 3 highlights this policy in detail). From the standpoint of Latin America, the Carter Administration was very inconsistent in its application of this policy. Latin Americans watched as some of the largest aircraft transfers in history went from the U.S. to Israel, Saudi Arabia, and Egypt in the spring of 1978, yet no similar considerations were being afforded to them. In terms of human rights standards, border tensions, and

[24]Richard F. Grimmett, "Conventional Arms Transfers to Developing Nations, 1991-1998," *The DISAM Journal* (Fall 1999): 36.

[25] Caesar D. Sereseres, Western Hemisphere expert for the US State Department, Washington D.C., interviewed by author, 22 March 2000. Dr. Sereseres described Latin American transfers as an "arms policy dumping ground" because it seemed to be the only region in which the US actually abided by its stated arms export policy of restraint (much to Latin America's chagrin).

GNP, Latin Americans saw little difference between themselves and other countries in the Middle East and Asia who were receiving American fighters.[26]

However, concerns over human rights, insurgencies, regional border disputes, and the possibility of renewed arms races have formed the central argument for U.S. restraint in Latin America. Some in Congress argued that introducing expensive front-line fighters would destabilize fragile democratic economies and that little need exists because we would provide for the region's security. However, when the U.S. refused to fill a country's arms request on these grounds, France, Russia, and Israel eagerly entered the market and sold front-line fighters such as the Kfir and Su-22 during the 1970s and '80s. Even under the threat of sanctions from the U.S., Latin American states turned to any exporter that would address their needs for military aircraft.

An interesting argument regarding the "wants and needs" of a country surfaces in the Latin American air export debate. Dr Frank O. Mora and LTC Antonio L. Pala pose the following questions: Who actually determines what a country's wants and needs are? Should the President stipulate the defense needs of another country? "Does the U.S. Air Force truly need the B-2 bomber in an age when it does not face a true competitor? Would the U.S. President respect, or follow, an externally imposed moratorium on aircraft purchases or development because some foreign leaders believe they are not necessary for our national defense?"[27] Indeed, the democratically elected governments of Latin America regard this as a slap in the face of their national sovereignty and a double standard regarding self-determination. This has been exacerbated recently as Latin America has attempted to become a more active participant in the international community. Several Latin American states have increased their participation in UN-sponsored peacekeeping missions and observer missions, they also supported the U.S. during the Haitian crisis. In fact, the first aircraft that flew into Baghdad after the Gulf War cease-fire was an Argentine Air Force Boeing 707. The Chileans, as well, regularly conducted helicopter operations in Kuwait after the war.[28]

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[26] Frank O. Mora and Antonio L. Pala, "US Arms Transfer Policy for Latin America," *Airpower Journal* 13, no. 1 (Spring 1999): 76-93.
[27] Ibid., 76-93.
[28] Ibid., 76-93.

Issues in Latin America highlight the importance of astute diplomacy and statesmanship regarding regional air-export policies. Such policies can foster either good or ill will, depending on how well they are crafted and perceived when compared to transfers in other parts of the world. Latin American expert Caesar Sereseres' experience in the State Department managing Latin American affairs has led him to believe that "prestige weapons" such as high-tech fighters are more significant in terms of their *diplomatic symbolism* than their military capability. Regarding the 1982 sale of F-16s to Venezuela, Sereseres holds that the export was more about political and symbolic function than an operational imperative.[29]

In 1996, the U.S. House of Representatives, under bipartisan support, urged the Clinton Administration to lift the ban on exporting fighter aircraft to Latin America. They argued that lifting the moratorium would be good for the region because U.S. exports—under strict State Department scrutiny—would push out other foreign military competitors. In 1997, the Clinton Administration responded by announcing an arms transfer policy to Latin America that puts them "on a par" with other regions of the world. This policy will consider advanced arms to Latin America on a "case-by-case basis." The Administration stated that, "In the last decade, Latin America has changed dramatically from a region dominated by coups and military governments to one of democracy and civilian control. Our partnership with countries in the region has reached a new level of maturity, cooperation, and dialogue."[30]

For this policy to be effective, it must embrace—to some degree—the transfer of advanced fighters. Fighter exports would serve not only as a means of increasing U.S. influence and leverage within the region but also as a vehicle for security cooperation, diplomatic good will, and mutual respect.

Regional Stability

FMS can be used to increase regional stability by balancing power. For example, the UAE sale can be viewed as a way of bolstering defenses in a volatile region where Iran continues to grow in military strength. These sales can also forge partnerships

[29] Sereseres.

and create trust between the U.S. and its allies, providing a solid foundation for building regional stability. Aircraft exports—especially front-line fighters—may offer a significant deterrent value. Would-be aggressors might be dissuaded not only by the capabilities of the aircraft, but also by the *implied threat* of potential U.S. involvement, which is made credible through FMS. The 1992 sale ('97 delivery) of 150 F-16s to Taiwan serves as an example of how the U.S. uses FMS to enhance regional stability via balancing power in favor of an ally, and hence deterring Chinese aggression. Others would argue the opposite is true. In September 1992, China protested the sale and withdrew from negotiations on limiting arms transfers.[31] In a similar vein, President Clinton's decision not to export Aegis destroyers to Taiwan in April 2000 was made largely to avoid angering China.

Procurement of 63 F-15s by Saudi Arabia in 1978 also tipped Israel's perception of the balance of power in the Middle East. Israel was concerned that the speed, agility, advanced fire control system, and air-to-air capability of this new air superiority fighter threatened—for the first time—Israel's air superiority in the region. Israel responded by requesting additional F-15s to bolster its fleet of 15 aircraft and by unsuccessfully lobbying Congress to limit the Saudis from acquiring AIM-9 Sidewinder heat-seeking missiles and extended-range (610 gallon) fuel tanks.[32]

Interoperability and Coalition Warfare

During the Cold War, the U.S. had an incentive to maintain a strong and robust military capability focused on defending against the Soviet threat. This force was largely a deterrent one—portraying power, but not necessarily using it. NATO countries, despite their differing capabilities, could stand side-by-side with the U.S. in common defense.[33] However, since the end of the Cold War, the well defined bipolar world has fractured into

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[30] The White House, *U.S. Policy on Arms Transfers to Latin America,* statement by the Press Secretary, 1 August 1997.
[31] Lt Col Frank S. Petty, "Defense Offsets: a Strategic Military Perspective," *The DISAM Journal*, Summer 1999, 74.
[32] Paul Y. Hammond, David J. Louscher, Michael D. Salomone, and Norman A. Graham, *The Reluctant Supplier. U.S. Decision-making for Arms Sales* (Cambridge: Oelgeschlager, Gunn and Hain, Publishers, Inc., 1983), 22.
[33] Major Todd C. Westhauser, "Improving NATO's Interoperability Through US Precision Weapons," Research Report (Maxwell AFB, Ala.: School of Advanced Airpower Studies, June 1998), 2.

multipolar uncertainty. This era—yet to be named—has seen the rise of "hybrid warfare" where low-level conflict, ethnic strife, disaster relief, peacemaking operations, and the like have taken center stage.[34] All this comes at a time when the U.S. has reduced its overseas forces by nearly 70 percent. Out of necessity, the U.S. has turned toward coalition warfare to help share the burden in dealing with these minor contingencies. Coalitions also provide combined strength and a source of operational legitimacy. Reduced forward presence by the U.S. ultimately means allies must play a greater role in maintaining international security. To do so effectively**,** coalition forces must have modern, reliable equipment and should be able to fully integrate with U.S. forces.

Exporting front-line fighters and high-tech weapons would help bridge this technology gap and reduce the U.S. workload. Operation Desert Storm exposed the disparity between U.S. capabilities and that of its allies. Only 5 of the 16 non-Middle Eastern members of the coalition (the U.S. included) sent combat air forces to the region. The size and technological capability of the United States dwarfed its partners, as shown by the U.S. flying 85 percent of the total combat stories and dropping the majority of precision-guided weapons. Only the United Kingdom and France also had the capability to drop such weapons.[35] Deliberate Force—the 1995 Bosnian air campaign—produced similar statistics. Here, the U.S. dropped 88 percent of the precision weapons.[36] Coalition partners, primarily due to technological limitations, were largely relegated to peripheral roles. Besides the inability to drop precision weapons, many coalition aircraft did not have secure, jam-resistant communications; updated electronic warfare systems; or advanced air-to-air missiles. In 1999, Allied Force—the air operation against Yugoslavia—once again demonstrated similar burden-sharing results.

It should also be noted that the U.S. was willing to sell precision weapons to these NATO allies but they were not bought—perhaps raising the argument that NATO needs to spend more on modernizing its weapons inventory (or the U.S. charge less for the PGMs). Nevertheless, these air operations serve as an example of why it is important that

[34] Paul Mann, "Fathoming a Strategic World of 'No Bear, but Many Snakes,'" *Aviation Week and Space Technology* 151, no. 23 (6 December 1999): 61.
[35] Westhauser, 2-3.
[36] Ibid., 3.

future air-exports carefully consider—even encourage—high-tech munitions sales. This policy should be emphasized for regions where the U.S. expects to invoke joint air operations such as the Middle East and Southeast Asia. The Clinton Administration's 1995 Conventional Arms Transfer Policy recognizes this disparity and seeks to rectify it via relaxing the export rules. Specifically, one of the policy's five main goals is, "to help allies and friends deter or defend themselves against aggression, while promoting interoperability with U.S. forces when combined operations are required."[37]

The Pitfalls of High-Tech Transfers

Liberal arms transfers, however, are not a panacea for regional stability or for the preservation of the defense industrial base. It is certainly arguable that any influence generated by an arms transfer is a difficult commodity to measure and one whose effect may be fleeting. In fact, a contrary argument can be raised that the U.S. is often manipulated and misled by the recipient governments who are more intent on acquiring high-tech American air technology than conferring influence over their affairs—thus raising the question of who is influencing whom.[38] In *The Global Politics of Arms Sales*, Andrew J.Pierre describes this phenomenon as "reverse leverage" over the supplier.[39] He cites the Vietnam War as one of the most striking examples. America's strong commitment to South Vietnam was manipulated by the Thieu Government through vetos of various U.S. peace proposals. Access to basing rights may also leave the U.S. vulnerable to reverse leverage. When the U.S. had basing rights in the Philippines, for example, Washington was limited in its ability to intervene with the Marcos Government concerning human rights. Additionally, Manila was able to demand substantial military and economic compensation in return for access to Subic Bay.[40]

Indiscriminate **FMS, especially with aircraft and air technology, can pose a two-fold threat to national security**. The first threat comes from the potential of our own weapons being used against us. This may be the result of an ally, after receiving U.S.

[37] McCurry, np.
[38] Hammond, et al., 267.
[39] Andrew J. Pierre, *The Global Politics of Arms Sales* (Princeton: Princeton University Press, 1982), 17.
[40] Ibid, 17.

military equipment, turning into a foe. The second threat comes from the potential that a purchaser may sell U.S. technology to a third party.

Arms exports to Iran during the 1970s serve as an example of a failed export initiative and illustrates the two-fold threat. During this time, the sale of arms to Iran skyrocketed. In fact, from 1950 to 1971, American arms sales to Iran totaled only 1.2 billion, but during the next seven years, the cumulative total burgeoned to approximately $21 billion.[41] In 1977 alone, the U.S. exported $5.7 billion dollars worth of equipment to Iran.[42] The list of weapons sold included 225 F-4s, 41 F-5s, 80 F-14s, and 160 F-16s (the F-16s were purchased, but not delivered). The Iranian Air Force was also to receive 7 AWACS (the only ones sold outside of NATO at the time) and long-range transports.[43] Amazingly, even after the Shah of Iran fell from power in 1979—leaving an anti-American regime—arms sales to Iran continued. It was only after the Iranian hostage crisis began in 1979 that sales were terminated. Interestingly, the Iranians tried to sell back the 80 F-14s they had purchased for $3 billion—as they proved difficult to maintain—but the U.S. was not interested.[44]

The Iranian debacle created deep worries in Washington that advanced weapons systems technology and secrets would be compromised. The Iranians were in possession of one of the world's most advanced air-to-air missiles, the Phoenix, as well as the F-14's Hughes radar and fire control system. This, along with the technical data and operator manuals would fetch a prime price in the Soviet Union, which lacked such technology. To add insult to injury, the Iranians posed a significant threat to the U.S. and Gulf region. The U.S. had to reckon with a country armed with the most advanced air-to-air missiles, 2,850 AGM-65A Maverick air-to-surface missiles, and 72 AGM-84A Harpoon anti-ship missiles.[45]

Obviously, the U.S. had exercised very little restraint in arms export to Iran. In fact, in 1972, then-Secretary of State Kissinger told the Shah that he could have any non-

[41] Ibid., 148.
[42] Ibid., 148.
[43] Ibid., 148.
[44] Ibid., 153.
[45] Wortman, 11.

nuclear weapon in the U.S. arsenal, including the F-15.[46] The Nixon decision to supply Iran with all the arms it wanted was made without exercising normal channels within the government, including the review process within the State and Defense Departments. Nixon ordered, "in the future Iranian requests should not be second-guessed."[47] Aircraft exports were based on enhancing American influence in the region *rather than a careful analysis* of Iran's defense needs, internal stability, financial status, and other considerations. There were also many signposts along the way to warn subsequent administrations and the DOD of the impending disaster. The Shah's unconstrained expenditures on American equipment were destabilizing the country. Social, economic, and political strain was evident as Iran shelled out 25 percent of its national budget on defense. This eroded the Shah's popular support, planted the seed for anti-American sentiment, and helped open the door for revolution.

Once the damage was done, isolating Iran from its technological and logistical base along with the passing of time and subsequent technological obsolescence has muted this threat. Ironically, between 1985 and 1986, the U.S. was once again willing to transfer other types of high-tech weapons to Iran, including TOW anti-tank missiles and HAWK surface-to-air missiles. In the "arms-for-hostages deal," the Reagan Administration sought release of seven U.S. citizens abducted in Beirut—held hostage by members of Hezbollah, a terrorist group with links to the regime of the Ayatollah Khomeini. Additionally, the U.S. hoped to re-establish diplomatic channels with Iran in light of its strategic importance and the potential threat of the Soviet Union meddling in the succession crisis that might follow the death of the Ayatollah.[48] This later line of reasoning is strikingly similar to the export-motivation themes discussed throughout this chapter.

Later, the President's Special Review Board (the Tower Commission) would investigate the arms-for-hostages affair and found the operation was "directly at odds"

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[46] Michael Brzoska and Thomas Ohlson, *Arms Transfer to the Third World 1971-85* (Oxford, NY: Oxford University Press, 1987), 55.
[47] Pierre, 145-146.
[48] Barry Rubin, "U.S. Policy and the Middle East, 1985-1988." This chapter was published in *The Middle East from the Iran-Contra Affair to the Intifada,*, by Robert Freedman (Syracuse University Press, 1991),

with other important policies, including the Administration's stance on terrorism and the Iran-Iraq war. The commission further stated that the arms transfers created an incentive for further hostage-taking by rewarding their actions and threatened to upset the military balance between Iraq and Iran and jeopardized stability among the Gulf States.

Clearly, the Iranian arms policy was a failure from the beginning. The U.S. was unable to keep the Shah in power and subsequent arms transfers attained neither a new relationship with Iran's hostile regime nor a reduction in the number of U.S. hostages. U.S.-Iran arms transfers also drove a wedge between America, Kuwait, and Saudi Arabia during this time. News of U.S. weapons sales to Iran prompted Kuwait, fearful of Iranian attack, to ask the Soviets for help in the protection of its tankers from Iranian attack. To this day, the U.S. remains concerned over potential Iranian aggression against friendly Arab states.

Part of the Iranian export failure can be linked to the lack of a formal framework for U.S. export policy. Still today, the U.S. lacks a working policy model upon which informed and consistent arms export decisions can be made. The potential for an F-22 and JSF export market in the near future makes this even more necessary. These aircraft will incorporate stealth technologies which, up to this point, have never been exported. Stealth platforms give the U.S. exclusive capabilities over any adversary. An established framework that fully considers issues of diplomacy, regional stability, and interoperability as well as the potential for exploitation must be in place before the sale. The U.S. can ill afford an export faux pas with its cloaked jewel, stealth.

Exports and Offsets

Offsets are industrial compensation practices that are often required by customers as part of the condition of sale of defense items (or services) to foreign countries. Offsets are associated with both government-to-government transactions and commercial sales. Offsets play a critical role in the export of most aerospace products. They become even more prevalent with the sale of high-tech aerospace systems such as fighters. With literally thousands of parts and components, an abundance of advanced technology, along

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n.p.; on-line, Internet, 12 April 2000, available from www.biu.ac.il/SOC/besa/meria/us-policy/data1985.html.

with extensive maintenance requirements, aerospace products are rich with offset opportunities. In fact, according to the U.S. Bureau of Export Administration, *91 percent of the dollar value of all offset agreements was written against aerospace exports between 1993-1996*.[49] Offsets heavily influence the defense industrial base (in both positive and negative ways) and they play an equally large role in international relations. They may also promote technology transfer and the proliferation of weapons systems which may influence national security and the international alliance structure. [50]

Background

Offsets can be categorized as "direct" or "indirect." Direct offsets involve an agreement for a transaction that is *directly related to the weapons system being purchased.* They usually requires the seller to acquire from the purchasing nation components or subcomponents of the system being purchased. Indirect offsets, on the other hand, require the seller to purchase things that are *unrelated* to the product being sold. These agreements typically require that a certain percentage of the purchase price be spent in the acquiring country's economy. Offsets generally take the form of co-production, licensed production, subcontracting, technology transfers, or overseas investments.[51]

In terms of financial gain, offsets can be a losing proposition for *both* sides, especially for modern military aircraft manufacturers who do not produce in mass quantities. Small production runs become very sensitive to changes in volume—the larger the order, the more the cost per unit falls. Unit cost-savings can be achieved by exporting aircraft—hence, an impetus for doing so—but when the export is tied to excessive direct offsets, net gains may soon be nullified.[52] In the end, it costs the U.S. taxpayer as sub-contractors inflate the price of subcomponents in anticipation of profit-gobbling offsets.

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[49] US Department of Commerce, "Offsets in Defense Trade," *The DISAM Journal*, Spring 1999. Article was extracted form an August 1998 US Department of Commerce study entitled, *Offsets in Defense Trade; A Study Conducted Under Section 309 of the Defense Production Act of 1950, as amended*. 62.
[50] Petty, 76.
[51] Brown, 65.
[52] US Department of Commerce, 59.

Undoubtedly, the biggest losses tend to occur when an aircraft is co-produced or subcontracted overseas. Not only is the overall volume taken away from the American industry; but on the other end, the foreign co-producer also loses in broad economic terms. This is because a duplicate factory must be established—along with its overhead—to produce an identical product in relatively small quantities. So why do offsets occur? Often the co-producing or subcontracting country stands to gain through *technology transfer* and *self-sufficiency* in armament production. However, the technology transfer is another cost to the U.S. taxpayer, as publicly funded research and development is usually not charged by the prime contractor when exporting the aircraft system, as the Department of Defense typically waves this cost. [53]

As an example of co-production inefficiency, the Japanese co-produced 200 F-15s at an estimated 250 percent of the cost to purchase them from the U.S. producer.[54] Japan also co-produced 130 F-2 fighters—a derivative of the F-16—*at five times the cost*, roughly $80 million per aircraft more than purchasing F-16s directly from the United States.[55] Though Japan's cost penalties are astounding and atypical, the expenditures do stay within their domestic economy rather than going abroad. Moreover, the offset may also help promote or preserve an indigenous defense base for a nation and infuse new technology into its economy. Co-production and sub-contracting may also introduce domestic firms to potential export partners.

Indirect offset deals can be very confusing, and sometimes seem to defy logic. For example, when McDonnell Douglas secured a contract to sell F/A-18s to Spain they also agreed, in turn, to market Spanish steel coils, chemicals, sunflower seed oil, sailboats, paper products, zinc, and marble in the U.S.[56] In another contract, a 150 percent offset was established for the sale of F/A-18s to Canada. When selling to the United Kingdom, aerospace contractors can expect offsets to range anywhere from 50 to 100 percent with the majority equaling *at least* 100 percent of the sale price.[57] Offsets are widely held by defense contractors as a "necessary evil" to secure the sale.

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[53] Ibid., 59.
[54] Ibid., 60.
[55] Ibid., 60.
[56] Petty, 66.
[57] Ibid., 66.

Caution must be exercised when drawing conclusions high offset demand made by foreign purchasers because they are often inflated by the use of "economic multipliers." Economic multipliers account for the indirect economic benefits that the purchaser will gain from the stimulation of their local economy through the offset agreement. In other words, one dollar in true offset money may be multiplied 10 to 20 times as the money is cycled through the local economy over time. For example, if a future fighter contract promised Norway a 100 percent return in offsets agreements—say on a $2 billion deal—in reality, perhaps only $100-200 million may *actually* be spent by the contractors on actual offsets, and economic multipliers compensated the rest. The *appearance* of a 100 percent offset arrangement, however, is useful in convincing foreign parliaments, and their public, to invest in U.S. equipment.

In general terms, developed countries seek offsets that involve *production*, *subcontracting*, and *co-production* rights to help support and maintain their industrial bases. Newly industrialized nations, on the other hand, often negotiate offsets that involve *technology transfers* relating to defense systems or the high-tech industry. Finally, less developed countries generally *desire indirect offsets* that may help stimulate business and build up the country's economic infrastructure.[58]

U.S. Offset Policy

In 1995, Congress sought to gain better control and oversight of offsets by adding the "Feingold Amendment" to the State Department Authorization Act, which requires real-time notification to Congress of any offsets being considered in connection with an arms sale. The State Department then followed by adding Section 114 (Reporting of Offset Agreements) to the Security Assistance Act of 1998. The DOD's standing policy has been one of not encouraging or participating directly in offset agreements. Accordingly, SAF/IAW is not allowed to participate in offset discussions, regardless whether the offset is germane to training, tactics, or interoperability issues.[59]

Offsets and the International Arena

There is concern that offsets could potentially lead to arms proliferation. In the past, importers of arms generally accepted older generation aircraft, but in today's competitive

[58] Petty, 69.

market, many countries insist on top-of-the-line technology packed in their fighters as part of an offset deal. Hence, the apparent U.S. military advantage can quickly dissipate via satisfying other countries' offset demands. Ironically, Lockheed lobbyists argue to Congress that "widespread proliferation" of very capable combat aircraft such as the F-15 and F-16 (the latter built and sold by Lockheed Martin) justify the need for the F-22.[60]

Technology is one of the most sought-after commodities in an offset deal. One quarter of all defense offset transactions involve the transfer of technology. The Korean F-16 deal required aircraft production in South Korea and the ability to access and manipulate the aircraft's software. The F-16 transfer to Taiwan was also contingent on the transfer of technology to build the hot section of advanced jet engines and a software facility which would allow for the limited manipulation of the aircraft's software. According to SAF/IAW, "software manipulation" is a misleading term and is better described as "reprogramming"—it can be likened to "selling them an Excel spreadsheet in which they can enter the data but cannot access the program code." [61] And for the decision maker, this sort of compromise may be worth the cost as other important U.S. interests are advanced through the sale.

On the positive side, *offsets promote the sale of U.S. equipment to allies. This, in turn, facilitates interoperability.* The U.S. may also benefit from offsets through *access to spare parts and overseas repair and depot facilities* that would otherwise not be available. Access to multiple supply lines and a variety of sources during combat provides both redundancy and flexibility.

Congruency in tactics and training is another aspect of interoperability. Most fighter sales have operations, manufacturer, and maintenance training packages (often via offset agreements) that are included.[62] This may be through the contractor, the FMS contract, or through the U.S. International Military Education and Training (IMET) program. For

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[59] Seaman.
[60] Federation of American Scientist, *Arms Sales Monitor*, No. 28, 15 February 1995, n.p.; on-line, Internet, 25 February 2000, available from http://www.fas.org/asmp/library/asm/asm28.htm.
[61] Software manipulation allows foreign purchasers to reprogram their EW systems to counter new or unexpected threats. They do not gain access to sensitive "source codes" as popular myth would have it. There are two parts to the EW software: the "MDX" portion, which only the U.S. can access and manipulate, and the "MDY" which, like a template, allows the purchaser limited reprogrammability their EW system.
[62] Petty, 74.

example, the UAE is negotiating a $1 billion weapons and training package with the U.S. government. Joint training forges strong ties between the U.S. military, her allies, and coalition partners. It also smoothes out some critical interoperability issues that may otherwise arise during combat operations.

Offsets are important in the preservation of the defense industrial base as well. They often provide the necessary leverage to secure a trade deal. The *1996 National Export Strategy* recognizes the effects of offsets on the industrial base, stating: "Offsets can also provide benefits from maintenance of defense system production lines and additional sales of U.S. spares and services over the lifetime of the exported hardware."[63] Interestingly, the UAE deal may, once all negotiations are complete, end up levying relatively small offset demands on the U.S. There are a couple of reasons for this. First, the UAE was unable to ask for a large direct offset package because they have no significant military aircraft industry. Second, since they are the first (and so far the only) country to buy the Block 60 F-16, keeping offset demands down may encourage other countries (such as Norway and the U.S.) to also purchase the aircraft thereby reducing the overall program cost. Essentially, if the UAE asks little in compensation for their $2 billion in R&D costs, others may be encouraged to buy into the weapons system and, in the long run, the UAE will ultimately save through cost sharing of maintenance, future upgrades, and the like.

In total, offsets play an important, yet often confusing, part in a high-tech aircraft sale. Should the decision be made to export the F-22, large offset demands by the purchasing country can be expected. Technology transfers, subcontracting, and indirect offsets will most likely be the means by which purchasing governments gain internal support for buying F-22s (or JSFs). F-22 direct offset requests more than likely will take the form of high-tech transfer demands, perhaps via contracts stipulating the assembly of sub-components and/or access to electronic source codes. U.S. reluctance to transfer these exclusive technologies may lead to heavy indirect offset demands equaling or exceeding the purchase price.

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[63] US Department of Commerce, *The National Export Strategy: A Strategic Response*, 1996, n.p.; on-line, Internet, 25 February 2000, available from http://www.ita.doc.gov/tpcc/3execsm.html

Conclusion

Though the U.S. FMS track record may not be perfect, a policy that pursues exporting front-line fighters must not simply be dismissed as "destabilizing." There is a fundamental difference between proliferating small arms to third-world countries and exporting front-line fighters to well-established allies in good international standing. In general, the U.S. has been successful with its fighter export policy. For the most part, it has successfully matched the needs of the defense industrial base to the needs of the international environment. So far, the U.S. has not had to face American-made fighters in combat—a testament to the restraint and discernment shown in U.S. export policy. This must be said cautiously, however, as the mere threat of being attacked by U.S.-made fighters has produced a disastrous result in the past. In 1988, the Navy Aegis cruiser USS *Vincennes* mistakenly identified an Iranian Airbus as an Iranian F-14 over the Persian Gulf, believing it to be maneuvering for attack, *Vincennes* targeted and destroyed the airliner, killing all 290 people on board. The British, too, were not well pleased to be on the receiving end of U.S.-made A-4 Skyhawks during the 1982 Falklands War. HMS *Coventry* was hit by three 1000 pound bombs dropped from Argentine Skyhawks, leaving 19 crewmen dead.

By and large, however, high-tech fighter exports have had a positive effect. They have bolstered the defense industry, served to promote regional stability, enhanced diplomacy, and helped bridge the technology gap between the U.S. and her allies. These efforts have also gone a long way toward making coalition warfare possible. National military strategy is dependant on coalitions; therefore, a carefully crafted and robust high-tech export policy is essential. For the U.S. to continue to be a major power, it must exchange in the commodities desired by friends and allies and address their perceived security needs. Exporting modern U.S. fighters often substitutes for U.S. intervention, U.S. overseas basing, U.S. global presence, and bilateral security guarantees and treaties.[64] As noted by Hammond, et al., in *The Reluctant Supplier*, such transfers are the "Hobson's preference." [65] Offsets, however, must be anticipated in any future export

[64] Hammond, et al., 271.
[65] Ibid., 271. A “Hobson’s choice,” as defined by the dictionary, means the choice of taking the thing offered or nothing at all.

decision. With exclusive air technologies at stake, care must taken and oversight must be exercised to avoid selling off national treasures such as stealth and classified manufacturing techniques. Just what *is* at stake will be described in detail in Chapter 3.

Chapter 3

Air Export Policy

Before entertaining the notion of exporting advanced aircraft such as the F-22, it is important to understand the general governmental control and oversight process that circumscribes the foreign sale of military technology. A historical background on the development of U.S. export policy will illuminate the matter, as will a brief description of the role of Congress and the Executive Office in an export decision. Stated export policies have varied widely from one president to the next; and, though the President has the ultimate voice on high-tech transfer decisions, domestic and international politics tend to be the primary drivers in the decision-making process. Though the actual decision to transfer a high-tech weapon is chiefly a political function, the oversight process for controlling technology exploitation and identifying the ramifications of the transfer is bureaucratic. This bureaucratic process provides the carpentry and masonry for the greater architecture of modern transfer decisions.

Historical Background

The United States has been in the business of exporting military equipment for well over a century. During World War I, the U.S. exported roughly $4 billion in munitions to its allies. Total exports naturally dropped off during the interwar years to about $10-15 million.[1] The U.S. established its first Arms Export Control in 1935 when Congress, after a decade of inaction, ratified the Geneva Arms Traffic Convention of 1925 and then went on to pass the Neutrality Act in August of that same year. The Neutrality Act of 1935 (evolving through subsequent Neutrality Acts of 1937 and 1939) gave the President a

[1] David J. Louscher and Michael D. Salomone, *Marketing Security Assistance. New Perspectives on Arms Sales* (Lexington, Mass.: D.C. Heath and Company, 1987), 186.

legal basis for establishing the general system for controlling arms exports. Specifically, it established the National Munitions Control Board under the purview of the Secretary of State and required those who manufactured, imported, or exported arms to register with the secretary. This act also authorized the Secretary to establish rules, regulations, and enforcement of arms export controls and authorized the President to create a list of items subject to these controls.[2] Shortly thereafter, the State Department established the Office of Arms and Munitions Control as a means of executing and administering this process. Along with this came the International Traffic in Arms Regulations (ITAR), this enumerated what were considered "arms, ammunition, and implements of war." For the most part, the ITAR has endured throughout the years.

Franklin D. Roosevelt first offered military equipment to the United Kingdom in September 1940 through his "Destroyers Deal" in exchange for the use of bases in the Caribbean and the Atlantic.[3] This transaction represented the first transfer where the recipient was not obliged to pay for the equipment Building on this, Congress passed the Lend-Lease Act in 1941 authorizing the President to sell, lend, lease, and transfer war material as he saw fit.[4] As World War II drew to a close, virtually all American allies (including the USSR) were the recipients of U.S. military exports. However, by 1947 American and Soviet ideologies were diametrically opposed to one another and it appeared that the Soviets intended to make a European land-grab. In response to Soviet expansionism, the Truman Doctrine was established in March 1947. This doctrine committed U.S. aid to countries requesting help in their efforts to thwart communist expansion.

In 1954, the Mutual Security Act reflected the doctrinal shift and repealed and superseded the Neutrality Act of 1939, changing its emphasis in several significant ways.[5] First, the legislation reflected a shift from isolationism to globalism based on the concepts

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[2] Ibid., 187.
[3] Paul Y. Hammond, David J. Louscher, Michael D. Salomone, and Norman A. Graham, *The Reluctant Supplier. U.S. Decision-making for Arms Sales* (Cambridge: Oelgeschlager, Gunn and Hain, Publishers, Inc., 1983), 3-4.
[4] Lt Col Michael N. Beard, "United States Foreign Military Sales Strategy: Coalition Building or Protecting the Defense Industrial Base," Research Report (Maxwell AFB, Ala.: Air War College, March 1995), 7.
[5] Louscher and Salomone, 189.

of mutual security and the Truman Doctrine. The Mutual Security Act of 1954 gave the President the authority to control and regulate exports of technical data and to deny import licenses for reasons of foreign policy or national security. The National Munitions Control Board was then eliminated, and its function was turned over to the Secretary of State.

Using the Truman Doctrine as a foundation, the Foreign Assistance Act of 1961 was established to legislate foreign military sales activities. This act provided the legal authority for the U.S. to provide goods and services to foreign governments which support American national security objectives. In 1969, ITAR was further revised such that controls on exports of "significant combat equipment" and technology transfers were strengthened.

In 1976, the Arms Export Control Act (AECA) refined the President's authorities as originally granted in the Neutrality Acts of the 30s and later by the Mutual Security Act of 1954. AECA became the main U.S. law to deal directly with the sale and export of weapons and other goods with a primarily military application. This act developed the criteria for items placed on the Munitions List. The AECA also authorized the President in section 38 to further U.S. security objectives and achieve mutual national defense requirements for,

> . . . furtherance of world peace and the security and foreign policy of the United States . . . to control the import and export of defense articles and defense services and to provide foreign policy guidance to persons of the United States involved in the export and import of such articles and services. The President is [also] authorized to designate those items which shall be considered as defense articles and defense services for the purposes of this section and to promulgate regulations for the import and export of such articles and services."[6]

The Role of Congress in Export Decisions

Essentially, the AECA sought to increase congressional oversight in the nation's arms sales process. It also marked a significant shift from the 1954 Mutual Security Act from

[6] By Executive Order 11958, the President has delegated these authorities to the secretaries of State and Treasury.

selling arms to *controlling* arms exports.[7] Much of this was brought about by Congressional concern over perceived renegade behavior in arms transfers by the Oval Office. The AECA also emphasized public disclosure and review procedures. This act, however, did not give Congress the authority to make decisions regarding arms transfers, it merely allowed it the right to make sales subject to disapproval. In the 24 years of the act's existence, Congress has yet to use this authority. Essentially, the legislation has served as a vehicle to put Capitol Hill under "close scrutiny" and has put the executive branch "on notice" that arms sales must be justifiable.[8]

The Role of the Executive in Export Decisions

As the chief executor of foreign policy, the President's role in arms transfers carries the most weight. Roosevelt's Destroyer Deal of 1940 marked the first significant transfer decision and set the stage for presidential involvement in arms brokering. The Truman Administration and its containment policy marked an important change in how arms transfers were approached. Where Roosevelt focused arms transfers on replenishing and bolstering *established* European and NATO allies, Truman—in the throes of a developing cold war—widened his export policy to include transfers to *developing* countries outside Western Europe. Furthermore, he broadened the scope of arms exports—using them as a stop-gap measure around the periphery of the Soviet bloc (to include China).[9] The Eisenhower Administration further expanded containment efforts (along with military aid) to "forward-area" countries and others including Latin America, Africa, and the Middle East. Eisenhower also brought the Cold War perspective to arms transfers by defining a "worldwide Soviet conventional military threat" which served as the baseline for arms transfer objectives—a convenient catch-all reason for alliances and arms exports that was invoked by succeeding administrations up to 1990.[10]

The next significant policy shift in arms exports occurred during the Carter Administration, which charged in the winter of 1976 that the Ford and Nixon

[7] Andrew J. Pierre, *The Global Politics of Arms Sales* (Princeton, NJ: Princeton University Press), 50.
[8] Pierre, 51.
[9] Hammond, et al, 4-5.
[10] Ibid., 5.

Administrations had a “policy of selling virtually anything to virtually anybody."[11] The Carter Administration initiated a policy of arms transfer “restraint.” The President, along with several of his key advisers (including Secretary of State Cyrus Vance), believed that the U.S. arms transfer program had "run amok."[12] Though there is some truth to this—consider the previous description of the Iran arms transfer debacle—Carter’s people failed to grasp the strong checks and balances that were in place through congressional oversight, even prior to the AECA of 1976. Nevertheless, President Carter sought arms sales restraint by establishing strict guidelines that included:

- Not being the first supplier to introduce advanced weapons systems into a region.
- Not selling newly developed or advanced weapons systems until they were operationally deployed within the U.S.
- Not permitting significant modification of advanced weapons solely for export.
- Not committing co-production agreements for significant weapons, equipment, and major components.
- Considering human rights within the recipient country.
- Establishing a dollar ceiling on the volume of new commitments for FMS and military assistance programs.
- Seeking more bilateral cooperation in reducing the "worldwide traffic in arms (but setting the example by acting unilaterally)."[13]

Despite this stated policy, by the end of his presidency, arms sales under the Carter Administration showed an overall *increase* rather than a reduction (the largest sales to Iran were during this administration). Arms sales did not become the "exceptional" instrument of foreign policy as declared in 1977.[14] Indeed, the endemic strength and persistence of arms transfers trumped countermanding policy and proved to be a continuing and important instrument of foreign affairs and a vehicle for domestic prosperity.

When President Reagan took office in 1981, he would stand Carter's export framework on its head. The Reagan Administration viewed the transfer of conventional arms, including high-tech fighters, as an essential element to the U.S. global defense posture and, not surprisingly, an indispensable component of foreign policy. Arms sales were evaluated primarily in terms of their "net contribution to enhanced deterrence and

[11] Ibid., 13.
[12] Ibid., 13
[13] Pierre, 52-54.

defense."[15] No longer was there any reference to human rights considerations. Nor would the United States jeopardize its own security through a "program of bilateral restraint."[16]

Currently, the Clinton Administration holds to an export policy similar to Reagan's. On February 17, 1995 the Administration announced its Presidential Decision Directive (PDD-34) on Conventional Arms Transfers. The Administration stated "that the sales of conventional weapons are a legitimate instrument of U.S. foreign policy, enabling allies and friends to better defend themselves, as well as support our defense industrial base."[17] The directive also emphasized that arms transfers were an important tool for deterring aggression, promoting regional stability, and increasing interoperability of U.S. and allied forces. PDD-34 was intended to be a summation and codification of the Administration's decision-making apparatus regarding arms transfers. The policy gave increased weight to specific conditions within each region as a response to the "changed environment of the post-Cold War era."[18] Arms transfers decisions would be made on a case-by-case basis and each transfer would be examined in terms of the dynamics of "regional power balances" and the potential for destabilizing changes in those regions. Holding to similar ideals as the Carter Administration, human rights could once again be found as a potential criterion for a transfer decision. Many of current air-export considerations can be found throughout PDD-34; because of their relevance, the Goals and Criteria sections are quoted in full:

> **U.S. Goals**:
>
> 1) To ensure that our military forces can continue to enjoy technological advantages over potential adversaries.
>
> 2) To help allies and friends deter or defend themselves against aggression, while promoting interoperability with U.S. forces when combined operations are required.
>
> 3) To promote regional stability in areas critical to U.S. interests, while preventing the proliferation of weapons of mass destruction and their missile delivery systems.

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[14] Ibid., 58.
[15] Ibid., 63.
[16] *Conventional Arms Transfer Policy*, the White House, 9 July 1981.
[17] *New U.S. Conventional Arms Transfer Policy*, White House, 17 February 1995, n.p.; on-line, Internet, 9 November 1999, available from http://www.dsca.osd.mil/PressReleases/ARMSTRAN95.htm.
[18] Ibid.

4) To promote peaceful conflict resolution and arms control, human rights, democratization, and other U.S. foreign policy objectives.

5) To enhance the ability of the U.S. defense industrial base to meet U.S. defense requirements and maintain long-term military technological superiority at lower costs.

General Criteria

• Consistency with international agreements and arms control initiatives.

• Appropriateness of the transfer in responding to legitimate U.S. and recipient security needs.

• Consistency with U.S. regional stability interests, especially when considering transfers involving power projection capability or introduction of a system which may foster increased tension or contribute to an arms race.

• The degree to which the transfer supports U.S. strategic and foreign policy interests through increased access and influence, allied burdensharing, and interoperability.

• The impact of the proposed transfer on U.S. capabilities and technological advantage, particularly in protecting sensitive software and hardware design, development, manufacturing, and integration knowledge.

• The impact on U.S. industry and the defense industrial base whether the sale is approved or not.

• The degree of protection afforded sensitive technology and potential for unauthorized third-party transfer, as well as in-country diversion to unauthorized uses.

• The risk of revealing system vulnerabilities and adversely impacting U.S. operational capabilities in the event of compromise.

• The risk of adverse economic, political, or social impact within the recipient nation and the degree to which security needs can be addressed by other means.

• The human rights, terrorism, and proliferation record of the recipient, and the potential for misuse of the export in question.

• The availability of comparable systems from foreign suppliers.

• The ability of the recipient effectively to field, support, and appropriately employ the requested system in accordance with its intended end-use.[19]

In sum, the President's personal philosophy on arms transfers is important; moreover, the foreign policy emphasis of an administration will naturally define where, how many, and what type of arms will be exported.

International Export Controls

During the Cold War, the primary multilateral forum for controlling the export of arms was the Coordinating Committee (COCOM). Established in 1947, this committee

included all the members of NATO (except Iceland), Australia and Japan. Its primary function was to prevent sensitive technology from being proliferated via arms transfers to the Soviet Union and its satellite countries. These members agreed to consult (and veto) each other on items to be exported and established a mutually agreed upon munitions list. In 1979, the Export Administration Act became the U.S. enabling legislation developed to enact the policies of the COCOM agreement. The EAA has policy goals which are similar to those of the Arms Export Control Act. The EAA also gives the President authority to regulate export of technologies to preserve national security. The Defense Department also has an important enforcement role within the framework of the EAA, as it is responsible for the maintenance of the Militarily Critical Technologies List (MCTL).

With the "East-versus-West" line blurred after the dissolution of the Soviet Union, the charter members of COCOM agreed to disband in 1994 and regenerate with another control forum.[20] The current administration seeks to develop the COCOM replacement based on the Wassenaar Arrangement (WA) on Export Controls for Conventional Arms and Dual-Use Goods and Technologies of 1995. WA began its work officially in 1996 with the U.S. as an active participant. The Wassenaar Arrangement has two main objectives. The first is to promote transparency in transfers of conventional arms and dual-use goods and technologies. The second is to promote greater responsibility for the same.[21] "The arrangement is intended to enhance cooperation to prevent the acquisition of armaments and sensitive dual-use items for military end uses if the situation in a region or the behaviour of a state is, or becomes, a cause for concern to the participating states."[22]

The WA differs from COCOM in that there is no "veto power" over the export of a particular system as before and operates on "national discretion." In terms of a U.S. air-export agreement, the U.S. would be obliged to report to the member countries what type

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[19] Ibid.
[20] Lt Col Wayne M. Johnson, "Seller Beware US International Technology Transfer and its Impact on National Security," Research Report (Maxwell AFB, Ala.: Air War College, December 1998), 3.
[21] "The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies," *The Chemical and Biological Weapons Non-Proliferation On-Line Educational Module*, 8 September 1999, n.p.; on-line, Internet, 19 March 2000, available from http://cbw.sipri.se/cbw/wassenaar.htm.
[22] Ibid.,

of technologies were exported. As with COCOM of the past, WA will most likely have little effect on U.S. air-export decisions.

The Air-Export Process Described

Many actors are involved in the decision to export advanced fighter aircraft. The aggregation of these actors into an export decision-making system is a dynamic process and, in many ways, ad hoc. It changes with each request—depending on the sophistication of aircraft or air-technology being considered for export and who is to receive it.

First, the process starts when a country expresses an interest in the acquisition of U.S. military aircraft; this may be channeled through ambassadors, defense attaches, security assistance officers, sales representatives of commercial firms, or others.[23] When the U.S. receives the formal request, the Department of State (DOS) is the primary office for handling it.[24] Within the DOS, transfer issues reside with the Assistant Secretary of State for Political-Military Affairs and the Under Secretary of State for International Security Affairs (ISA). When advanced military equipment is being requested, the majority of the actors in the transfer process reside in the DOD. In essence, the DOD acts as the executor and implementer of State Department policy.

Within the DOD, the primary office for action and supervision is the Defense Security Cooperation Agency (DSCA). The DSCA manages security assistance programs and is the focal point within the DOD regarding government-to-government arms transfers. If a transfer is requested through commercial sales, the Office of Defense Trade Controls within the State Department handles it. However, if a major weapon system is requested through commercial channels, such as the UAE purchase of the F-16 Block 60 aircraft (which had to be routed this way since the USAF doesn't own this aircraft), the State Department will seek DOD advice and a report on the military and technological

[23] Paul Y. Hammond, David J. Louscher, Michael D. Salomone, and Norman A. Graham, *The Reluctant Supplier. U.S. Decision-making for Arms Sales* (Cambridge: Oelgeschlager, Gunn and Hain, Publishers, Inc., 1983), 87.

[24] For a more detailed description of the arms transfer review process, refer to Hammond, et al, *The Reluctant Supplier,* pp 85-89, as well as SAAS student Major DelGrego's, "The Diffusion of Military Technologies to Foreign Nations," Research Report, Chapter 3.

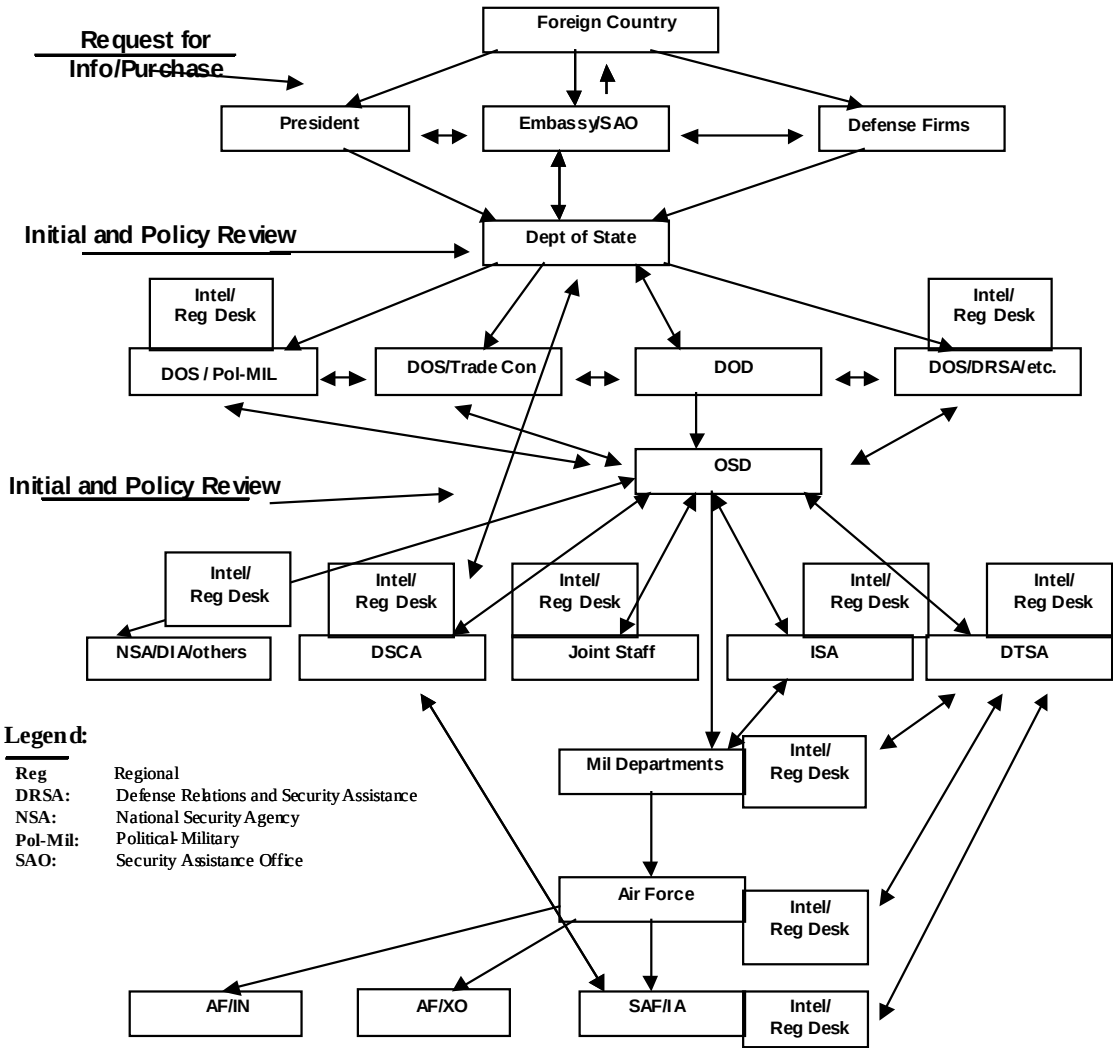
ramifications of the sale.[25] In the case of the UAE sale, an additional FMS contract was established to cover the training portion of the deal. A technology assessment may also be required if the proposed transfer involves high-tech equipment. The Defense Technology Security Administration (DTSA) is responsible for this, and their primary function is to determine whether or not advanced technologies are being risked by the transfer. The DTSA handles both commercial and government-to-government transfers.[26]

Air-exports also receive a great deal of attention at the service level, and the individual services have their own security assistance divisions—the Air Force has its International Affairs directorate under the Secretary of the Air Force (SAF/IA). One of the important functions of this office is managing controlled military information. Controlled military information may be classified or unclassified, and the act of revealing this information is referred to as "disclosure." Guidance regarding disclosure issues is found in the National Disclosure Policy regulations and in political and military "baselines." SAF/IA is responsible for developing baselines for Air Force fighter aircraft. Baselines provide a proactive means for handling the multitude of "requests for information" and purchase orders as they are submitted. Baselines may be used to establish an export configuration of a particular aircraft and may even pre-designated countries for approval (such as NATO or treaty countries).[27] Though baselines speed up the process (the number of requests for U.S. military equipment usually exceeds 10,000 per year), they tend to be conservative in nature. Exceptions to these baselines can be granted by the National Disclosure Policy Committee (NDPC). This is an interagency working group comprised of members from DOS, Commerce, the CIA, the JCS, and DOD.[28] This committee recommends whether the request for disclosure should be approved or not, and forwards its decision to the Secretary of Defense for final approval. The Secretary of Defense then passes his decision on to the State Department.

Research by William J. DelGrego in *The Diffusion of Military Technologies to Foreign Nations* describes this process as "more than adequate" to control the release of

[25] Hammond, et al, 95.
[26] Major William J. DelGrego, "The Diffusion of Military Technologies to Foreign Nations," Research Report (Maxwell AFB, Ala.: School of Advanced Airpower Studies, March 1996), 19.
[27] DelGrego, 21.
[28] Ibid., 21.

advanced technology and the transfer of our front-line fighters.[29] In fact, he asserts the process can be excessive and its internal workings are complex, representing a "labyrinth of control," see Figure 1.



Source: Major William J. DelGrego, "The Diffusion of Military Technologies to Foreign Nations," Research Report (Maxwell AFB, Ala.: School of Advanced Airpower Studies, March 1996), 22.

Figure 1. The Labyrinth of Control

A Note about Dual-Use Technologies

It should be noted that the control measures in place for military exports may be different from those that regulate the transfer of dual-use technology (items that may have useful function in both commercial and military sectors). The Commerce Department

[29] DelGrego, 17.

controls dual-use items and, depending on the commodity, it may be up to the individual exporter to determine under which department's purview their product would belong.[30] Hence, there is often confusion as to whether a particular export falls under State or Commerce jurisdiction. Since the State Department's controls—as described above—are generally more restrictive than Commerce controls, a company trying to export a particular aerospace technology that has a potential dual-use function may apply to the Commerce Department in an attempt to circumnavigate strict licensing controls.[31]

Protecting Stealth and other Advanced Technologies

Air-exports with advanced or stealth technologies, such as are found on the F-22, require a specialized, component-by-component review as specified by export regulation. This process starts at the service level (in the F-22's case it would be the USAF) who will initiate an export feasibility evaluation through a four-step process. First, an "Integrated Product Team," consisting of members from the Air Force, DOD, and defense contractors, will be created to examine potential export issues specific to the aircraft under consideration. Next, the Product Team will notify the Tri-Service Committee on their findings. This committee reviews the weapon system and its technologies—comparing them to the Critical Military Technologies List, the Low Observabilities (LO) List, and the Counter-LO List—and then makes a decision whether the aircraft needs to be reviewed by the Low Observable Executive Committee (LOEXCOM)—the third step in the process. For aircraft as advanced as the F-22 and JSF, LOEXCOM review is required. LOEXCOM is comprised of the following agencies:

- Vice Chairman of the Chief of Staff
  - Co-chairman of board.
- Undersecretary of Defense (OUSD), Acquisition and Technology (A&T).
  - Co-chairman of board.
- Principal Deputy for OUSD(A&T).
- Director of Special Programs OUSD(A&T).

[30] Johnson, 13.

[31] For more information on Dual-use technology proliferation issues, see Lt Col Johnson's "Seller Beware US International Technology Transfer and its Impact on National Security." Johnson maintains that the US needs to pull back dual-use technologies under one organization for centralized control. He recommends creating an interagency group under the Department of State since national security issues are involved.

- Director of System Test and Engineering OUSD(A&T).
- Director of Strategic and Tactical Systems (OUSD, Science and Technology).
- DARPA Director.
- Director of Operations, Test, and Evaluations (OT&E).
- Chairman JCS Acquisition Directorate (J8).
- OUSD for Policy.
- OUSD for Research and Engineering.
- Principals from the Services: Requirements (XOR), Acquisitions (AQ), Director Air Warfare, Navy (N-88).

Details of the proposed export are presented to each of the board members individually, followed by a formal meeting of the entire board. Additionally, the Tri-Service Committee will direct a Tri-Service Blue- and Red-Team analysis of the export. This team studies the export and develops an independent risk analysis of the system. The team also researches and answers any questions brought-up by the LOEXCOM. These teams are normally staffed by all three services, and the Air Force Red Team component is represented by SAF/AQL. The Red Team's job is to ask questions concerning the risk of a high-tech export; the Blue Team's job is to answer each question with a specific plan for protection measures. When responding to questions from LOEXCOM, the red/blue team has approximately four days to produce the answer. If an answer to a risk question cannot be answered within this timeframe, LOEXCOM closes down and the whole process starts from square one at a later time. Hence, it is imperative for the USAF (or whoever is sponsoring the export) to have completed a thorough and in-depth risk analysis before the convening of the LOEXCOM, otherwise the process may take several years to complete.

Once the weapon system has been approved by LOEXCOM for export, the review process moves to the State Department which forms an Exception to National Disclosure Policy Committee. This committee is comprised of the CIA, the NSA and other senior government representatives. They will then make the final decision regarding the technology release associated with the export. In the case of the F-22, many parts and components will require an exception to national disclosure policy (ENDP).

After the State Department approves the export, state-to-state negotiations between the U.S. and the importing country may begin. Since the F-22 sale will be under the

auspices of FMS, negotiations remain at the government level (including USAF inputs). From the contractors' prospective, their customer becomes the USAF who, in turn, hands down the details of the negotiated contract. The contractor then responds to the Air Force with the cost of the export product. Once the sale is finalized, an FMS tax is added to the final price of the system as a means of paying for the government's role in the transaction—to include costs for the International Systems Program Office, SAF/IA's legwork, and other expenses.

Conclusions

Several domestic and international elements work to shape an air export policy and—for the most part—the U.S. has made rational decisions as what items should be transferred and to whom. It is apparent that there is plenty of oversight in the system to prevent inadvertent technology transfers, and there are plenty of agencies at work to spell-out the ramifications (from their perspective) of an air-export decision. This system is complex and cumbersome and has been built around a notion of restraint in arms trade. It also seeks to protect the U.S. technological lead. The UAE F-16 transfer has arguably pushed technology transfer restraint to its limit. However, as the labyrinth demonstrates, the technological consequences of this transfer should have been well documented and the decision made (right or wrong) was done from a fully informed position. In terms of future advanced technology exports, such as the F-22 and JSF, disclosure issues will be fully developed and explored through the Integrated Product Team, Tri-Service Committee, and LOEXCOM oversight process—insuring the jewel of stealth remains sufficiently cloaked.

Chapter 4

The F-22 and its Exclusive Air Technologies

You could fix every problem in the Army for ten percent of the F-22 program.

Major General Jay Montgomery Garner
Assistant Chief of Army Staff for Operations an Plans, Force development

The advanced technologies, qualities, and capabilities that the F-22 Raptor and JSF will offer are unique and well advanced over today's front-line fighters and hence affect an export decision. JSF development is in something of an amorphous state with the primary contractor selection not scheduled until fall of 2001. A decision that will define its specific export configuration is also not expected for another three years.[1] Therefore, the attention of this discussion will focus on the F-22, which is currently in the early production and testing phase. In addition, the F-22 is the more capable of the two fighters—with a unique speed, maneuverability, and stealth advantage. The JSF will not be as effective at defeating enemy air defenses on its own. In relative terms, where the F-22 would have the radar cross-section (RCS) of a marble—or bumble bee—the JSF would represent that of a golf ball. This does not necessarily imply that JSF's technology is any less advanced, but it does imply that the export of F-22s will pose even more difficult decisions for policy makers. Hence, by addressing the advanced technology concerns associated with export of the F-22, a solid framework can be constructed for answering similar questions down the road with JSF. Since the JSF *is intended to be exported*, thinking about these issues now—by constructing a viable F-22 export policy—may help prevent unintended technology proliferation later.

[1] Adam J. Herbert, "Decision on JSF Exportability not Likely for Three Years, Official Says," *Inside the Air Force*, 11 February 2000.

The F-22 includes *several* exclusive technologies, qualities, and/or capabilities absent in any other fighter being flown today. However, it is the aggregation of several key attributes which sets the Raptor apart from the others. These attributes can be categorized into the following areas: *stealth, speed, agility, and the fusion of sensors and avionics.* Additionally, the advanced manufacturing process used to develop the F-22 is exclusive—no other country is currently capable of producing an aircraft with this level of advancement.

Stealth and avionics aside, an argument can be made that other modern fighters, such as the Eurofighter, Rafale, or Su-37 can potentially rival the Raptor's performance in one or more of the key areas mentioned. None of these fighters, however, have successfully integrated all these areas into a single stealthy system. True, the F-22's agility is challenged by the Su-37, but it is the synergistic effect of combined maneuverability and stealth that makes the F-22 significantly more lethal. Each of these key attributes will be addressed, but it is important to keep in mind the significance of these capabilities both individually and in aggregate—as they are blended into a single weapons system. It is also important to recognize that the following discussion is focused only on the superior qualities of the F-22—the things relevant to an export policy—it is not intended to be a sales pitch for the fighter, but should raise issues regarding the protection of proprietary technology.

Background

The F-22 is intended to be the U.S. front-line air superiority fighter with an initial operational capability date of 2005.[2] The quest for air superiority took fighter development through three distinct periods.[3] Between 1915 and 1960 the focus of fighter development was on speed, rate of climb, and high altitude capabilities. This culminated in the first- and second-generation jet fighters of the 50s and early 60s. The second period of fighter development spanned the 60s and was characterized by advancements in

[2] David Aronstein, Michael Hirschberg, and Albert Piccirillo, *Advanced Tactical Fighter to F-22 Raptor: Origins of the 21st Century Air Dominance Fighter* (Reston, Va.: American Institute of Aeronautics and Astronauts, Inc., 1998), 1.

[3] General Richard E. Hawley, "The F-22 Raptor: Ensuring Air Dominance for the Future," article submitted by ACC for publication into Aerospace America Journal (June 99 Edition). Written by Major E. West Anderson for submission by General Richard E. Hawley, Commander Air Combat Command.

maneuverability, agility, flexibility and multi-role capability. This set the stage for the third and fourth generation fighters of the mid-to-late 70s such as the F-15 and F-16. From the late 70s to the present, stealth has been the focus of aircraft design. Though not a fighter, the F-117 represented the U.S. breakthrough in stealth technology and set the standard for low observable characteristics desired in the next fighter. The F-117, however, was able to sacrifice speed and maneuverability to achieve its stealthy profile, this would not be an acceptable trade off for the future air superiority fighter. Lockheed Martin's F-22 successfully achieved stealth qualities while retaining agility and maneuverability that exceeded the capabilities of today's fourth-generation fighters. On top of this, the F-22 brought other advantages: supercruise (supersonic cruise speeds sustained without the use of afterburners), increased combat radius (relative to current-day fighters), along with integrated avionics and sensor fusion and rapid deployability.

Stealth

Stealth technologies initially developed in Lockheed's F-117 program provided a foundation for the low-observable (LO) characteristics of the F-22. However, significant advances in overall design, radar absorbent materials and structures, low-observable sensors and avionics, engine treatments, and low-observable inlet-exhaust systems have occurred since the initial fielding of the F-117. To achieve very low radar signatures, the F-22's weapons must be carried internally and all airframe features that could create detectable radar reflections (including antennas and engines) had to be specially designed and appropriately treated. Airframe shaping, extensive use of radar absorbent materials, embedded antennas, reduced signature nozzles, and a fixed array antenna have produced major reductions in radar signature—on the scale of several orders magnitude less than conventional fighter aircraft.

Supercruise

The F-22's F119 engines will deliver more thrust without afterburner than most conventional engines in afterburner. This characteristic allows the Raptor to efficiently cruise at supersonic airspeeds of Mach 1.5 in its military power setting (the highest non-afterburning setting). This capability significantly expands the F-22's operating envelope

in terms of both sustained speed and range (or radius) of operations over today's fighters.[4] The F-22 (without any external fuel tanks) has a 200% range advantage over an F-15 carrying 610 gallons of additional fuel in an external tank. The F-15 is known for its range and loiter time. High sustained speeds combined with stealth will also reduce or negate the ability of enemy ground defenses to detect, track, and target the F-22. This will theoretically allow it to penetrate sophisticated air defense systems un-harassed. Rapid and stealthy penetration, along with air-to-ground munitions capable of destroying air defense systems, may allow the F-22 to disrupt or destroy an enemy air defense network in support of follow-on friendly forces entering enemy airspace on strike missions.

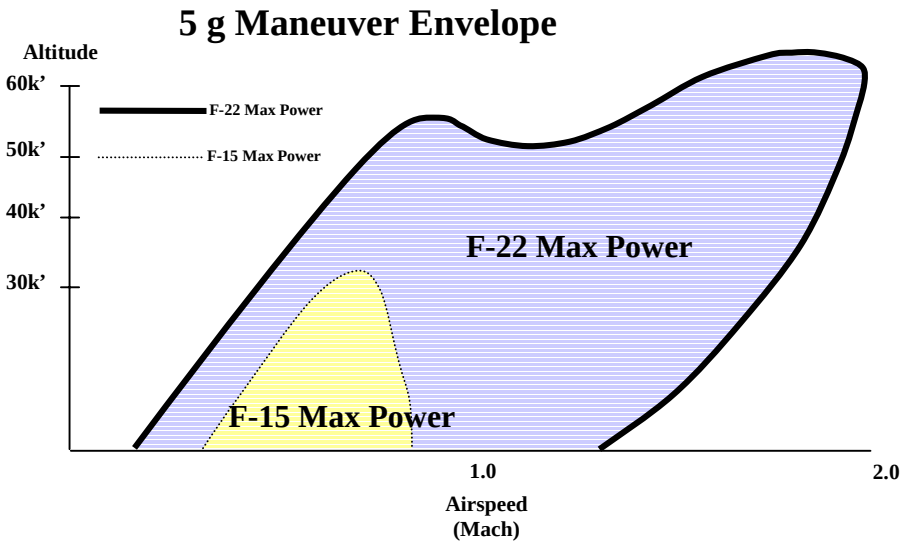
Supercruise capabilities are also advertised on the Eurofighter (EFA), however juxtaposing its parameters with those of the F-22 reveals an important distinction. EFA can only supercruise (at Mach 1.2) in a "slick" configuration—meaning no external armament is present on the aircraft. Obviously, the real significance of supercruise is within an operational or combat environment, when the jet is laden with its weapons—the Raptor will supercruise with a full load of fuel and weapons.

Agility

The F-22 is the first maneuverable stealth aircraft, in other words, a *true* stealth fighter. Though agility and stealth characteristics are often at odds with each other, the Raptor's maneuverability will exceed that of the F-15, F/A-18, and F-16 throughout most of the flight envelope. Part of the maneuverability advantage is gained by generating huge amounts of thrust. The F119 engines will produce more thrust than any current fighter engine. Each engine is rated at 35,000 pounds. By comparison, the engines powering the F-15 and F-16 have thrust ratings ranging from 23,000 to 29,000 pounds. Additionally, it will be the only aircraft capable of achieving high levels of maneuverability while in supersonic flight, even at high altitudes. This grants the F-22 an exclusive maneuvering zone, where other aircraft that attempt similar maneuvers will lose airspeed and sink through the thin air. High-altitude maneuverability has distinct

[4] "F-22 Features," *Military Airplanes*. Boeing Co., 2000, n.p.: on-line, Internet, 23 February 2000, available from http://www.boeing.com/defense-space/military/f22/f22features.html.

advantages when attempting to intercept high-fast fliers such as the MiG-25 Foxbat. To successfully complete an intercept against this threat, the F-15 must jettison any external fuel tanks to reduce drag, and then can execute only small changes to its intercept geometry at high altitude for fear of bleeding excessive energy. Neither of these are required by the F-22—it retains its speed and maneuverability thereby expanding its high-altitude engagement capability. Vectored thrust is part of the reason the F-22 does so well at high altitude—pushing the nose around via thrust rather than demanding more lift off the wings in the thin air pays large dividends.



Source: Lockheed Martin Corp.

Figure 2. Maneuver Envelope: F-22 vs. F-15

Vectored thrust along with an advanced flight control program also lends itself to impressive maneuvering capabilities at the other end of the airspeed spectrum. The aircraft is controllable at speeds much lower than the highly maneuverable F/A-18 Hornet—an aircraft known for its slow-speed fighting capability.[5] In its basic combat configuration (all internal carriage of weapons, no external stores), the F-22 provides

[5] "F-22 Raptor 'Maneuverability,'" Edwards AFB Public Affairs Office, 7 Jan 2000, n.p.; on-line, Internet, 24 February 20000, available from http://afftc.edwards.af.mil/articles98/docs_html/splash/apr98/cover/maneuver.htm.

virtually an unlimited angle of attack (AOA) capability.[6] The aircraft has no AOA limiters and no restrictions on its flight path. Hence, it can maneuver in the post-stall regime with the aid of integrated flight controls and its two-dimensional trust vectoring. To prevent structural overstress, the flight control system provides load-limiting corrections to pilot input as a function of aircraft gross weight, much like the F-16.

Arguably, the Sukhoi Su-37 can be placed in the maneuver class of the F-22 with its steerable nozzles and thrust vector control system. The aircraft is basically a Su-35 with AL-37FU engines—which are derivatives of the AL-31F, but modified for thrust vectoring. Though the high AOA capability found in the Su-37 may challenge the F-22's maneuverability, the F-22 achieves this performance without compromising its stealth signature—an important and exclusive combination. As an interesting side note, Sukhoi financed its Su-37 development via payments earned through the sale of an Su-27 license to China.[7]

Integrated Avionics

Integrated avionics are one of the most essential features of the F-22. The level of integration is far beyond that of any other fighter aircraft. With current fighters, pilots are tasked with monitoring various displays, interfacing with them, and then prioritizing the information being presented. The F-22 seeks to reduce the pilot's workload by combining many sensors and their information onto an integrated display. This is known as "information fusion" and greatly improves cockpit automation, thereby improving the speed and accuracy of assimilation of information by the pilot. Though some of today's more advanced fighters do have integrated displays, the level of integration is not nearly as extensive as that of the F-22.

Avionics are also integrated in a manner which permits a "fault-tolerant architecture" to be established.[8] This architecture allows common integrated processors (CIP) to perform a variety of functions—sharing their resources—and reducing the amount of

[6] "F-22 Raptor 'Carefree Abandon,'" Edwards AFB Public Affairs Office, 7 Jan 2000, n.p.; on-line, Internet, 24 February 20000, available from http://afftc.edwards.af.mil/articles98/docs_html/splash/apr98/cover/carefree.htm.
[7] John Pike, "Su-37," *Military Analysis Network*. Federation of American Scientists, 11 March 1999, n.p.; on-line, Internet, 14 April 20000, available from http://www.fas.org/man/dod-101/sys/ac/row/su-37.htm.
[8] Aronstein, Hirschberg, and Piccirillo, 171.

unique sensor processing equipment (or task-specific hardware). Various physical sensors can actually share the same processors. Therefore, a small number of CIP modules form the building blocks for different avionics systems. The CIP modules have the ability to emulate any of the electronic functions via automatic reprogramming. This architecture also reduces the number of unique hardware components and allows functional redundancy without the physical duplication of each component. For example, if the module acting as a radio fails, one of the other modules will automatically reload the radio program and takeover its function.[9] Should additional failures cause the back-up modules to become fully committed, the system can then reconfigure itself to use what resources are available and will then begin a task prioritization routine. No other aircraft has this capability.

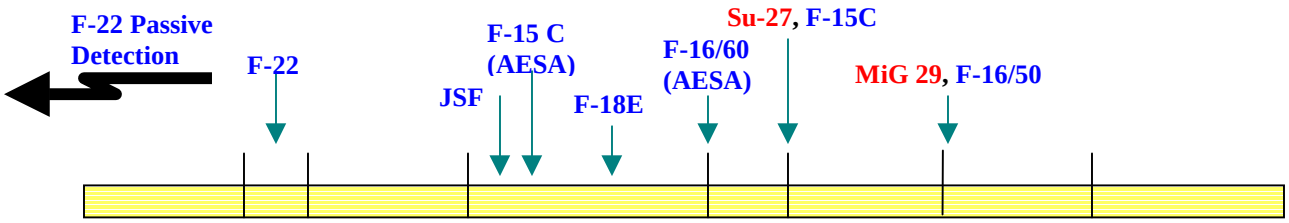
Whenever possible, sensors such as the antennas and apertures are integrated and combined—known as sensor fusion. This also offers weight and space savings and will reduce the cost of ownership through commonality of components. Finally, increased commonality lends to economies of scale on the production end.[10]

As fighter data link technology is finding its way into modern cockpits, the F-22 will incorporate advanced systems such as Link 16 and an Intra-flight Datalink (IFDL) . IFDL provides a unique secure F-22-to-F-22 data link that communicates unique, time critical voice and data message sets. The Raptor's networking feature will allow communication with a fighter's wingmen without the dependence on radio communication—a must for stealthy operations. This IFDL system is unique in that it uses a low probability of intercept (LPI) datalink to maintain the tactical advantage of stealth.[11] With LPI, the radio frequency (RF) band signal will attenuate in the atmosphere, thereby making it very difficult to detect by enemy monitoring devices.

One of the most advanced avionics features of the F-22 is its APG-77 radar. This active electronically scanned array (AESA) radar is composed of over numerous/multiple transmit-receive (TR) modules. Each of these modules is a self-contained transmitter,

[9] "F-22 Raptor 'Common Integrated Processor,'" Edwards AFB Public Affairs Office, 7 Jan 2000, n.p.; on-line, Internet, 24 February 20000, available from http://afftc.edwards.af.mil/articles98/docs_html/splash/apr98/cover/CIP.htm.
[10] Aronstein, Hirschberg, and Piccirillo, 172.
[11] Major Keith A. Seaman, SAF/IAW, Washington D.C., interviewed by author, 8 December 1999.

phase shifter, receiver, and pre-amplifier. In a sense, each TR module is its own "mini antenna." Since each element is capable of both transmission and reception, different elements can be doing different things at the same time. Multiple beams—with different waveform characteristics—can be created so that the radar may track a set of known targets and search for others *simultaneously*.[12] According to F-22 engineers, this feature will lead to a "variety of novel operating modes and a quantum leap in electronic countermeasures capability."[13] A pilot can use a set of radar beams to detect and fix the range of ground targets while using a second to communicate. "Anything that can be done with X-band RF (radio frequency) energy can be done with that antenna."[14] Electronic beam steering allows radar energy to be redirected in an extremely rapid manner. This also eliminates the need for physically sweeping the antenna, as on the F-15. The agility of the radar allow it to rapidly redirect RF energy The APG-77 will provide longer detection ranges than today's premiere fighter radars, the F-15's APG-63 and –70. The following chart highlights the significant range advantage of the F-22 over today's fighters.



Source: *Aviation Week and Space Technology*.

Figure 3. F-22's Radar and Passive Detection System's Range Advantage

Part of the radar's increased performance is obtained through "cleaner" electronics; the electrical pathways from the transmitter to the antenna and back to the receiver are reduced, thereby eliminating much of the system noise.[15] These functions are now all self-contained within the active array. The APG-77 radar should bring unprecedented

[12] I n actuality, the radar timeshares between search and track functions—switching modes so quickly (on the order of nanoseconds) that it appears to be simultaneous to the pilot.
[13] Aronstein, Hirschberg, and Piccirillo, 182-183.
[14] David A. Fulghum, "F-22, JSF Designed for Distinct Roles," *Aviation Week and Space Technology* 152, no. 6 (7 February 2000): 53.
[15] Aronstein, Hirschberg, and Piccirillo, 180.

levels of reliability; with an active array, there is no longer the possibility of a single-point failure at the transmitter or receiver. Several array elements could fail without noticeably impairing the radar's performance. In addition, by eliminating the physical sweep of the antenna, mechanical failures within this system will also be reduced.

Weapons Configuration

Though the F-22 does not introduce any new or unique armament, it is important in terms of an export policy, to understand its combat capability. To reduce drag and increase stealth, the F-22 internally houses six radar-guided AIM-120C Advanced Medium-Range Air-to-Air Missiles (AMRAAM) in the main weapons bay; two heat-seeking AIM-9M (or its improved variant, the AIM-9X) Sidewinder short-range missiles in side weapons bays; and one M61A2 20-mm cannon. It can employ its ordnance throughout its entire maneuvering envelope.

The aircraft also will be capable of carrying Joint Direct Attack Munitions (JDAMs) (two 1,000-pound GBU-32s in place of four of the AIM-120Cs). JDAM is a low-cost guidance kit which converts existing unguided free-fall bombs into accurately guided "smart" weapons. This is done by adding a new tail section to the munitions. The new tail contains an Inertial Navigation System (INS)/Global Positioning System (GPS) guidance system that provides highly accurate weapon delivery in any "flyable" weather. JDAM can be dropped from altitudes in excess of 40,000 feet and up to 15 miles from a target.[16] Updates from GPS satellites along with the INS help guide the bomb to within 10 to 13 meters of the target.[17] The ease of JDAM employment makes it possible for the F-22 to concentrate on achieving air superiority yet "swing" to dual-role missions when time and conditions permit. In essence, the F-22 will gain air supremacy so quickly and efficiently that alternate missions must be considered to keep the Raptors gainfully employed throughout the duration of the conflict.

F-22 Exclusivity

Indeed, the F-22 features several exclusive technologies, qualities, and capabilities absent from most of today's frontline fighters. Neither Eurofighter or the Rafale share

[16] Hawley.

such qualities—the level of stealth, supercruise, sensor fusion and advanced integrated avionics appear to be exclusive to the Raptor. More important is the combined effect of these capabilities—along with excellent maneuverability—that makes the F-22 an exclusive *weapon system*. David North, Editor-in-Chief for Aviation Week and Space Technology made the following remarks in August 1999:

> Recently, I flew the F-22 cockpit simulator in the unclassified, and less capable, mode in Arlington, Va. I was impressed with the integrated sensors and automated combat capability of the fighter in the air-to-air mode. But it was the difference of the F-22's advantage of stealthiness that was the most striking . . . In June, I flew the Dassault Rafale. The French fighter has better stealth characteristics than the aircraft it is replacing, the Dassault Mirage 2000-5, and with planned system upgrades, it will be a formidable multimission aircraft. Both the Eurofighter and Saab Gripen are newer-generation aircraft than the F-15, *but none is in the same air superiority category as the F-22* [emphasis added]. It would be wise to conclude that the U.S. might face one of these European aircraft as an adversary. Moreover, Russia is marketing fighters some say could better the F-15.[18]

The following table depicts a USAF assessment of the F-22 compared to its potential rivals of 2005. The reader should note the overall advantage the F-22 enjoys over any other aircraft.

Table 1. How the F-22 Compares to the Emerging Threat

	Today		*2005*		
	Fulcrum	Flanker	EFA	Rafale	Su-35
Maneuverability	**P**	**A**	**P**	**A**	**A**
Radar Detection	**A**	**A**	**A**	**A**	**A**
Range	**A**	**P**	**A**	**P**	**P**
Radar Cross Section	**A**	**A**	**A**	**A**	**A**

Source: USAF assessment using Defense Intelligence Agency data.[19]

P…Parity
A…Advantage

[17] Ibid.
[18] David M. North, "No Russian Roulette for the F-22," *Aviation Week and Space Technology* 152, no. 8 (2 August 1999): 114.

[19] John A. Tirpak, "Can the Fighter Hold Its Edge?" *Air Force Magazine* 83, No. 1 (January 2000): 27.

Critical Technology Protection on the F-22.

Recognizing the overall level of advancement of the Raptor, the Air Force in conjunction with Lockheed Martin— its primary builder—has taken the first steps in technology protection for F-22 foreign military sales. Charles Buzze, F-22 Advanced Product Development Manger at Lockheed Martin Aeronautical Systems, described groundbreaking work in the field of technology protection.[20]

Protection from exploitation of the F-22's hardware must be addressed on two levels: the systems level and the individual-component level. Lockheed Martin tackled this problem by first considering the over 700 sub-components of the aircraft and then identifying which of the components contained technological or functional aspects that could pose security concerns. Doing this reduced the number of components to roughly 215 items. A risk analysis for each item was conducted, as well as an analysis for the "rolled-up" aspects of the parts acting as an integrated system. For example, a transistor component to the F-22 radar has certain exploitation vulnerabilities, but its integration into the radar and fire-control system poses yet another set of vulnerabilities. Each facet of potential exploitation had to be considered. This included the potential for reverse-engineering**,** where technological secrets are acquired through disassembling and analyzing components of the aircraft along with the threat of subsequently restoring the original capability of a component if, in fact, it had been exported in a sub-optimized mode. Also considered was technology exploitation, where there is risk of certain technological aspects of the F-22 being exploited for unintended purposes such as transferring the aircraft's radar-absorbent coating technology to cruise missiles.

After thoroughly analyzing each component and system in terms of their vulnerability to exploitation, a "critical technology list" of roughly forty items was generated. Each item on this list was classified as high-risk, medium-risk, or low-risk and subjected to a "risk mitigation plan" (a plan or procedure aimed at reducing the risk of exploitation). Risk mitigation options included anti-tamper measures, deletion/degradation of capabilities, and other safeguarding measures. Though specific

[20] Charles Buzze, F-22 Advanced Product Development Manger, Lockheed Martin Aeronautical Systems, Marietta, GA. Interviewed by author, 4 February 2000.

details are classified, the F-22 has an array of protection measures including anti-tamper devices. As a hypothetical example, if a foreign customer were to tamper with certain components of the F-22 system, they may be surprised to find that engines will no longer start or multi-function displays will no longer turn on . . . Risk may also reduced by ensuring all sensitive software resides in the volatile memory only—any sensitive, unencrypted information can be automatically "dumped" as a result of a power loss, such as in the event of a downed aircraft.

At the direction of the Secretary of the Air Force, International Affairs (SAF/IA), Lockheed has defined various export configurations:[21] The F-22 configuration- It can be reasonably speculated that configuration would also have commensurate levels of performance degradation.

Due to the complex and interrelated nature of the risk associated with individual aircraft components and their interaction within a system, Lockheed has developed a CD ROM, along with a search engine, to aid in answering risk questions that may be asked by the LOEXCOM or others as they ponder the possibilities of an F-22 export policy. This CD is known as the "Technology Reliability Britannica." If, for example, LOEXCOM has a concern with the exploitation risk associated with, say, the aircraft's leading edges, this can be entered into the Britannica program and it will identify *where and how* risk reduction measures were taken with that particular component (and how it affects the system as a whole). This is the first time that such a tool as been used to quantify and identify the risk associated with an aircraft export.

It is hoped that this program will prevent the time-consuming process of forming a Red and Blue Team to investigate a question posed by the LOEXCOM that couldn't be immediately answered during the session. Questions such as the exploitation consequences of an enemy acquiring the GPS system following an aircraft crash can be resolved immediately by the Britannica—the answer should be at the asker's fingertips.

[21] Current law actually prohibits any exportation of the F-22. The Obey amendment, Appropriations bill Public Law 106-79, Section 8092, sponsored by Congressman Obey in 1997 states, "None of the funds made available in this Act may be used to approve or license the sale of the F-22 advanced tactical fighter to any foreign government." Hence, any future export of the aircraft must include an amendment to this law.

Conclusions

The F-22 is a new generation of fighter to which there is currently no equal or near competitor. Only the U.S. aerospace industry appears to possess the technological expertise required to balance and combine stealth, supercruise, agility, and sensor fusion. Accordingly, Raptor's technology is a solid ten years ahead of its foreign competitors.

Evidence also indicates that the Air Force, along with the prime contractor, have developed a thorough program for identifying, quantifying, and mitigating risk associated with an F-22 export. Additionally, the complex and highly electronic nature of the aircraft provides some inherent exploitation protection. Without special access to the program, it is impossible to accurately assess the risk associated with exporting the F-22. However, it is also reasonable to assume that even with the best technology protection measures in place, there will be some risk of exploitation, especially with stealth design characteristics. Decision makers must carefully consider this risk along with the potential political and security advantages gained from an F-22 export deal—a conceptual model for accomplishing this will be addressed next.

Chapter 5

Building an Air Export Policy Framework

Capitalists will sell me the rope by which I will hang them . . .

Vladimir I. Lenin

With the "operating environment" of an air-export policy established and the unique attributes of the F-22 identified, it is now possible to make an informed decision as to whether or not the F-22 is exportable and if so, to whom. Since this discussion has started from a broad view of U.S. arms transfer considerations, including U.S. policy and control measures, it is therefore possible to construct a basic framework in which *any* future air-export may be considered. This will be done first—addressing the general framework—and then placing the F-22 decision within it.

The "Maintenance Hedge"

Before constructing a framework for analyzing export decisions, it is instructive to first outline how the U.S. can, in some ways, insure itself against a poor high-tech air export decision. There exists a potential for "turning-off" maintenance and technological support to countries who purchased U.S. high-tech weapons and subsequently have either fallen out of political favor or have betrayed America's trust by using the weapons for unintended purposes. Combat lethality is not just a function of sophisticated machinery—the maintenance and technological support are every bit as important. This maintenance "hedge" was so effective against Iran that their most capable air defense interceptor became a white elephant after U.S. support was terminated. When Venezuela bought their F-16s in 1982 without a viable maintenance or training program, the aircraft were reduced to symbolic function only—their operational teeth were missing (along with the logistical tail). The Saudis, who had grown accustomed to the complete

technological, maintenance, and training support inherent in their U.S. fighter purchases, were shocked to find that their acquisition of British Tornados did not include any follow-on support, and the contract had to be renegotiated so the aircraft could function.

Offsetting the Maintenance Hedge

The maintenance hedge against air-exports, however, can be threatened by offsets. Offset deals may take away foreign dependence on U.S. maintenance, technology, and replacement parts support. Co-production agreements such as those made over various F-16 sales may allow countries who fall from favor with the U.S. to turn to countries like Turkey for support. U.S. offsets toward Israel have given their aerospace industry the technological know-how to produce and sell combat capabilities to countries previously denied such capabilities by the U.S. For example, when the U.S. refused to sell Venezuela aerial tankers for their F-16s fearing that such a capability would make the aircraft offensive in nature, they turned to Israel for help. Israel provided Venezuela with conversion kits, which transformed their commercially purchased Boeing 707s (from the U.S.) into tankers (707-394Cs, also known as KC-137s).[1]

National Security is the Bottom Line

In the most absolute terms, an air export policy is a function of America's security strategy. The stated goal of the National Security Strategy (NSS) is to enhance America's security with effective diplomacy and with military forces that are ready to "fight and win."[2] The NSS seeks an integrated approach to conducting foreign policy using the military, the diplomatic corps, foreign assistance programs, and executive leadership as tools to shape the international environment.[3] Secondly, it seeks to bolster America's economic prosperity. The strategy identifies economics as being "inextricably linked" to U.S. security interests and contends that national prosperity depends on America's ability to compete and win in international markets.

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[1] "Boeing 707 (C-137, C-18, E-8, E-6 and E-8)," *Encyclopedia of World Military Aircraft,* on-line, Aerospace Publishing Ltd., 8 May 2000.

[2] White House, *A National Security Strategy for A New Century*, "Preface," May 1997, n.p.; on-line, Internet, 19 March 2000, available from http://www.whitehouse.gov/WH/EOP/NSC/Strategy/#II.

[3] Ibid., "Advancing US National Security Interests" section.

Earlier, the two sides of an air-export policy coin were identified: the first being the "domestic factors" (America's economic prosperity—contingent upon a strong DTIB) and the second being "international relations factors" (diplomatic relations, military capability and interoperability, regional stability, and so on). In other words, the major elements of an air export policy have a direct correlation to the elements within the U.S. National Security Strategy.

This leaves us with a bottom line: **an export decision must—in some fashion—yield a net gain for national security**. When all the elements that factor into a specific air-export deal are considered, they must tip the balance in favor of enhanced national security. Therefore, the export policy framework must be subordinate to, and operate within, the U.S. National Security Strategy. There is no absolute equation that would fit—or accurately model—all export decisions. Each air export decision involves unique factors that affect national security, and these are weighted differently from one situation to the next. In other words, wise statesmen under good counsel must consider the domestic and diplomatic aspects of an air export decision along with its potential for technology proliferation within an overall context of national security. The following outline summarizes the various elements identified which must be considered and weighted by the decision makers:

- **Domestic Elements:**
  - Value to preservation of DTIB (Preserving production lines).
  - Value of technological advances through FMS.
  - Total economic gains for commercial sector (sale versus offsets).
    - Are there offsets attached that negate overall profit?
    - Do associated offsets risk unintended technology migration?
- **International-Relations Elements:**
  - How does the export contribute to regional stability in terms of:
    - Deterrence value.
    - Positive coercion value.
      - Does this strengthen ties between U.S. and receiving country?
    - Does it enhance stability of : government / military / economy.
    - Does sale destabilize relations with other countries in the region?
  - Does the export gain access, leverage, and influence within countries or regions?
  - Does the export convey a symbolic gesture such as trust or goodwill?
  - Does the air-export provide leverage against nuclear proliferation?

- Will competing supplier countries fill the order if the U.S. does not?
  - Has implications for DTIB security, technology advancement and security, and counter-threat capability.
- Coalition warfare and interoperability issues:
  - Does sale enhance integration of U.S. forces with country in question?
  - Does sale help bridge a military technology gap?
- Country compatibility:
  - Ideological compatibility.
  - Political, diplomatic & economic compatibility.
    - Is there a potential for reverse leveraging?
    - Is there a potential for a loss of diplomatic relations?
    - Does buyer have the proclivity to sell off technologies or exploit them for unintended purposes (3rd country sale, etc)?

- **Technology Risks:**
  - Potential for technology migration:
    - Can technology be extracted and then transitioned to unintended purposes?
  - Information Exploitation:
    - Can engineering or intelligence data be extracted?
      - May also be conducted by a third-party country through intelligence gathering methods (Reconnaissance / SIGINT / ELINT).
  - Counter-Exploitation Capability:
    - How well can the U.S. counter the transferred technology in a combat environment?
  - Capability Restoration:
    - How easily can the purchasing country restore downgraded or deleted capabilities of the weapon system? Or
      - Ex: Restoring the full stealth potential of the aircraft, etc.

An air-export decision can be thought of in terms of placing these elements on a scale, or balance, and measuring them in terms of the net gain to national security. Some factors will carry more weight than others. How they are weighted is dependent upon time- and context-sensitive variables. Some of these variables include: the economic and security context within the region at the time of sale, the nature of the international security environment, the status of the domestic economy, the health of the DITB, the specific article being sold, political initiatives, public interest and support, and the relationship between the U.S. and purchasing country (including the trustworthiness of the buyer). Figure 4 depicts how a typical air-export decision can be conceptualized in the overall context of national security and prosperity.

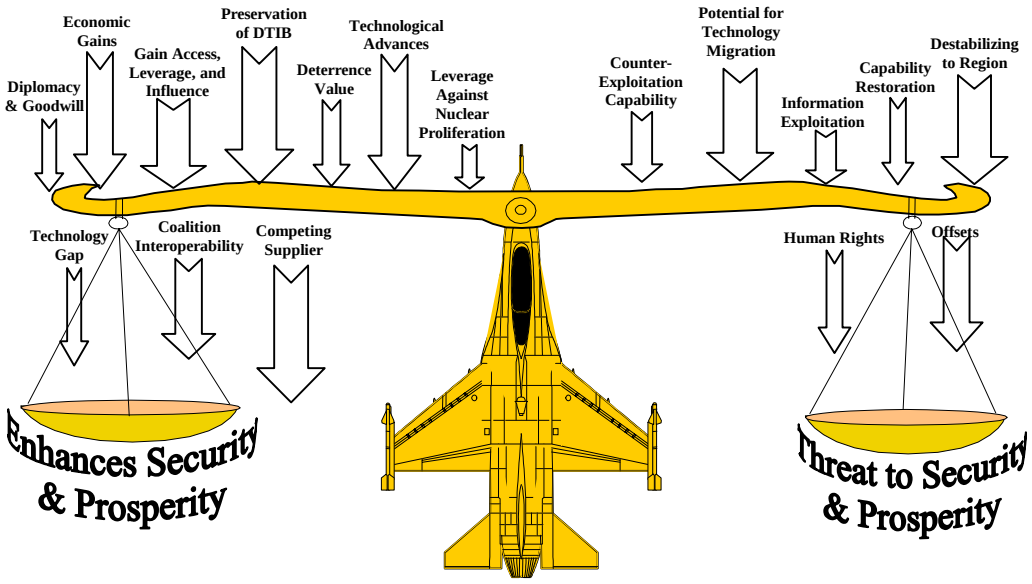

Figure 4. Air-Export Decision Elements

Each element that factors into an export decision can be relatively weighted by importance. Placing this concept into a matrix may further quantify the elements and provide a more functional device for decision making. Applying such a matrix to the UAE export will serve as an example and helps understand the puzzling high-tech UAE decision in two ways. First, it highlights that there is more behind an export decision than mere defense industry profit or deterrence initiatives. Second, it brings to light the importance of the context in driving the relative weighting of each decision factor. See Table 2.

Table 2. UAE Air-Export Decision Elements

Elements Enhancing Security & Prosperity	Relative Weighting 1_{low}—5_{high}	Threat to Security & Prosperity	Relative Weighting 1_{low}—5_{high}
Technological Advances: *$2 Billion in R&D; AESA radar, advances in countermeasures & counter-countermeasures*	5	**Reverse Leverage From Other Countries:** *Israel may demand compensation*	4
Deterrence Value: *Iran, Iraq counterbalanced*	3	**Potential For Technology Migration**	2
Preservation of DTIB: *Extends F-16 production line through 2007*	4	**Information Exploitation**	2
Gain Access, Leverage, and Influence: *Strengthens U.S. foothold in Persian Gulf*	4	**Capabilities Advantage:** *Capabilities beyond U.S. fighter: LPI radar, advanced EW systems, etc.*	3
Competing Supplier: *France's Mirage/Rafale fighters*	4	**Offsets & Recoupment Fees:** *Probably will be low—for "buy-in."*	1
Economic Gains: *$6.4 billion*	3	**Threat to JSF Program Costs:** *Block-60 may negate a future JSF market*	3
Coalition Interoperability: *U.S. weapons and equipment*	2		
Technology Gap: *Upgrades old aircraft*	2		
Symbolic Function	2		
Total	29	**Total**	15

Table 2 indicates that foreign competition and protection of the DITB were significant elements in the decision to export Block 60s to the UAE. The type of technology released marked a significant departure in the U.S. air-export policy—for the first time technology far more advanced than what was found in front-line American fighter aircraft was sold to a foreign country. In reality, however, this was inevitable. In order to win against the foreign competition and to continue to advance the DITB, cutting-edge technologies had to flow out of the F-16 production line. *The fact that the UAE will have better technology than American fighters is more a testament to the age of the U.S. inventory than it is a departure in export policy.* Today, foreign purchasers can find the similar capabilities while window-shopping at the Rafale or the Eurofighter production plants.

What is also notable about the UAE decision matrix is the relatively low threat of technology exploitation. This is due primarly from the UAE's lack of an indigenous techological base to exploit the Block 60 system. There was some concern by the DOD of "intermingling" between the Block 60 program and French personnel. To mitigate the threat of French exploitation, the UAE agreed to build secure U.S./UAE-only facilities. These facilities will give the UAE the abilty to rapidly reprogram their EW systems to counter any unforeseen Iranian threat without compromising U.S. technological secrets. Offset penalties and recoupment of R&D cost may also be kept small by the UAE to encourage buy-in from other countries (previously discussed).

However, the potential for UAE to attract multiple buyers through low-offsets and low R&D taxes—along with the aircraft's attractive advanced technologies—may have profound consequences for the JSF program. To prespective buyers, it could appear that the Block 60 would offer most of what JSF will offer—at a lower price. In some areas, the Block 60 offers capability advantages over JSF, such as in maximum speed. Most certainly, the biggest comparitive disadvantage of Bolck 60 is its lack of stealth—something many countries may not overly concerned with. The Block 60 may be competitively priced with the JSF and current F-16s and, perhaps more important, it will use the normal F-16 support infrastructure—an attractive feature to those contries which already own F-16s. The Block 60 is also attractive because it is a known quantity, based on a tried-and-true airframe, whereas the JSF is shrouded in secrecy with unproven performance. Should several countries turn away from the JSF in favor of the Block 60, the JSF program could find itself with rising R&D costs and a more expensive aircraft in the long run. Hence, effect on the JSF program was considered a liability in the above UAE decision matrix.

By comparison, a Latin American export decision has the same net result but a significantly different weighting scheme. See Table 3.

Table 3. Latin American Air-Export Decision Elements

Elements Enhancing Security & Prosperity	Relative Weighting 1_{low}—5_{high}	Threat to Security & Prosperity	Relative Weighting 1_{low}—5_{high}
Symbolic Function: *Diplomatic goodwill*	5	**Destabilizing to Region**	4
Preservation of DTIB	3	**Potential for Technology Migration**	2
Competing Supplier	4	**Information Exploitation**	2
Gain Leverage, and Influence	4	**Use of System/Technology for Unintended Purposes:** *Cross-boarder skirmishes, insurgencies*	2
Deterrence Value: *Cuba?*	2	**Human Rights** *Government treatment of citizens*	2
Total	20	**Total**	16

Air-Export Decisions: Political and Ad Hoc

Considering how wide the range of weighted decision variables may be, two important observations become evident. First, high-tech air-exports will—and must be—made on an ad hoc, case-by-case basis. The ever-changing international security arena and the political and domestic forces at home make it so. Second, regardless of standing export policies, actual decisions to sell high-tech arms are driven by the "right politics." With a stroke of a pen the executive office or legislature can override standing policies and international forums to execute foreign policy and secure national interests. Kissinger's offer to sell "any non-nuclear weapon in the U.S. arsenal" to Iran and President Reagan's 1982 export of F-16s to Venezuela—despite contrary standing policies—serve as reminders.

Offsets also require careful consideration. In order to prevent offsets from interfering with national security objectives, decision makers must also weigh the merits of the offset, especially co-production agreements, in a similar manner to those offered for export decisions. Additional care must be taken to avoid governmental interference with the free market. Many offsets will have non-defense-related agreements attached—these should be left to the businessmen. However, any agreement that directly affects the

U.S. or a foreign country's military capability or has significant ramifications for the international security landscape should be addressed at the State Department level.

Additionally, a policy change that allows some of the lower-level agencies (such as SAF/IAW) a voice in offsets may be beneficial. These agencies usually have the most active role in managing the security aspects and assessing the ramifications of any given air-export proposal. In many areas, they are the best qualified to coordinate non-profit, operational-related issues that often arise during offset negotiations—such as joint training opportunities, interoperability concerns, etc. As it stands now, these agencies are not allowed to listen to or participate in offset discussions, preventing valuable insights and ideas from being heard that could either enhance the deal or provide the senior decision maker with a more complete perspective of a military-related offset.

F-22 Eligible: Who and When

It is now appropriate to apply the general air-export framework to the F-22. At this point, it would be naive to dismiss the notion of exporting the F-22 solely on the grounds of technology and capability protection. However, this will be a central issue. What makes the F-22 question unique from exports such as Block-60 F-16s to the UAE is the overall level of technology, as the F-22 moves beyond advanced technologies and capabilities to the realm of the exclusive. Chapter 3 identified four exclusive areas: stealth, sustained speed, agility, and integrated avionics / sensor fusion. In total, these technologies are, by most estimates, roughly ten years ahead of the competition. Though the Block 60 F-16 will offer advanced EW techniques and an AESA radar, the F-22's significant radar detection range advantage (see Figure 2), level of sophistication, and sensor fusion are still in a league of their own. The Raptor maintains performance advantages—electronically and physically—while maintaining a stealthy profile.

However, the export control process (along with its "labyrinth") and rigorous LOEXCOM review would provide adequate oversight measures and a thorough analysis of the technological and capability ramifications of an F-22 export. In addition, on the contractor's end, adequate technology protection measures appear to be incorporated into the F-22 configuration A (export) variant. Though its specific protection measures are classified, from an academic standpoint the F-22's level of electronic sophistication may

also provide inherent protection and ample opportunities for built in "maintenance hedges." Anti-tamper micro-chips, scrambled electronic code, electronic firewalls, and tamper detectors may be infused throughout the system's electronic architecture. One of the touted features of the F-22's maintainability and reliability is that, "extensive self-diagnostic and built-in testing features are present on virtually every piece of hardware on the aircraft."[4] These features may also provide convenient opportunities for safeguards, tamper detection, and alerting features that are "present on virtually every piece of hardware on the aircraft."

Quantifying Risk

Protection measures, however, are only part of the equation for limiting the risk of exploitation. The other, and perhaps most significant part is limiting the *probability* for exploitation. This is a function of the nature of the purchasing country—its motivations and proclivity to use F-22 technologies and capabilities for unintended purposes. A "risk matrix" is depicted in Figure 5:

[4] "F-22 Raptor 'Safety and Maintenance,'" Edwards AFB Public Affairs Office, 7 Jan 2000, n.p.; on-line, Internet, 24 February 20000, available from http://afftc.edwards.af.mil/articles98/docs_html/splash/apr98/cover/safety.htm.

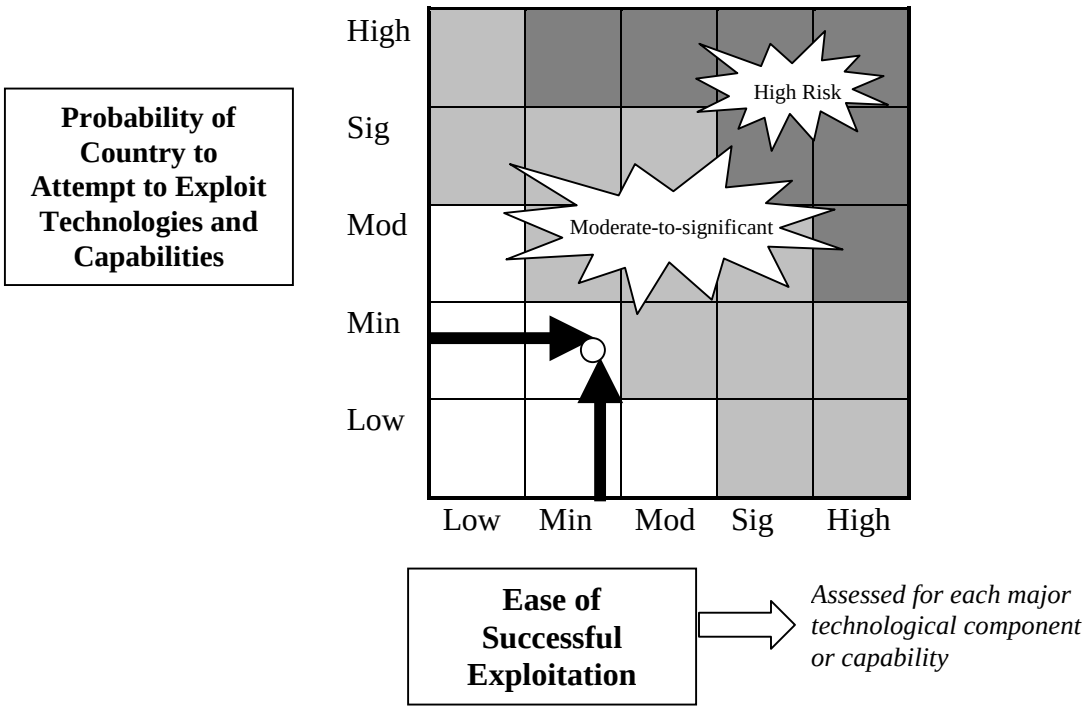

Figure 5. Risk Analysis Matrix

The results of this matrix may then be plotted in a similar manner against the "consequences of occurrence," which is a measure of the severity of the consequences given an exploitation attempt was successful.[5] This would provide a complete picture of the risk involved with each sensitive component/capability being exported. Indeed, many items can be protected from exploitation, but others such as the intricacies of design, radar signature, emission characteristics, etc., are difficult to protect. Therefore, there must be a reduction in the "y-value" of the graph—or probability of a country to exploit—*by limiting the export to only trustworthy allies*.

Should offsets be considered with an F-22 export where foreign contracts are awarded for parts or partial production, this type of risk analysis would be critical. According to Lockheed-Martin, some of the most highly guarded secrets associated with the F-22 are the technology and techniques used in the production of its parts and components.

[5] Lockheed Martin uses such a matrix for quantifying risk. The above matrix is a simplified variant of their risk matrix.

Stick to the ABCs

Who are the U.S.'s most trustworthy allies? Three allies stand out as true contenders. These countries have a long history of standing by America's side, supporting American policies and ideals, and have proven trustworthy with technological and military secrets. They are Australia, Great Britain, and Canada, often referred to as the "ABC" countries in military circles.

Australia. Shared strategic interests, values, and heritage are the bedrock of the Australia-U.S. alliance. The two countries have a history of close defense and security cooperation—with Australian and U.S. forces fighting alongside one another in both World Wars, Korea, Vietnam, the Gulf War, and Somalia.[6] The Australia-New Zealand-U.S. (ANZUS) Treaty is the central document which aligns and formalizes U.S.-Australian strategic interests and provides the framework for cooperation in intelligence areas, defense technologies, and logistics and support arrangements. There are other agreements but the ligatures that connect the two nations are more subjective and create a bond stronger than a formal treaty. Common cultures, values, and a similar heritage are part of that link. The immigrant-nation heritage of both countries and its melting-pot effect has established similar worldviews and the similar desire for self-determination.

Moreover, these links between the U.S. and Australia have produced commonalities regarding international affairs and security concerns. Within the Pacific region, the Australians realize the U.S. is the great power and that their security depends on a positive and close relationship with the U.S. They have been willing to put Australian troops under operational control of U.S. commanders in World War II, Korea, and the Vietnam War. According to Genta Hawkins Holmes, United States Ambassador to Australia, "Our militaries have exercised together so extensively and for so long that when real life contingencies occur, our forces pull together as if by reflex."[7]

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[6] Hon Alexander Downer, Minister for Foreign Affairs, "Australia and the United States: Old Friends and New Priorities," speech to the American Chamber of Commerce, 5 August 1999, n.p.; on-line, Internet, 23 March 2000, available from http://www.dfat.gov.au/media/speeches/foreign/990805_acc.html.

[7] Genta Hawkins Holmes, United States Ambassador To Australia," The Future Evolution of US-Australia Relations," an address before the Australia Institute of International Affairs, 27 October 1999, n.p.; on-line, Internet, 23 March 2000, available from http://www.usis-australia.gov/transcripts/1999amb1.html.

Finally, there is the economic relationship that binds the countries in a unique way. The U.S. and Australian economies are so interlinked and alike that the Australian-American business cycles are practically mirror images of one another.[8] Rivalry between the countries takes place primarily in the agricultural market, where trading is particularly strong. However, neither rivalry nor Australian security initiatives with other countries have compromised U.S. military technology or mutual trust.

Canada. It would be hard to argue against the assertion that Canada is America's most intimate ally and friend, enjoying the highest level of trust, recognition of mutual security interests, and diplomatic cooperation. In fact, Canada and the U.S. share the world's largest bilateral trading relationship. The undefended border between them stands as evidence of the common political, economic, social, and cultural values the two nations share.[9] The cooperative security between the U.S. and Canada was cemented in 1940 with the signing of the Ogdensburg Agreement, which acknowledges the "indivisible nature of continental security" and pledges mutual defense assistance and cooperation to one another.[10] In the 50s, ties were further strengthened with construction of the Distant Early Warning (DEW) Line of radars and the creation of North American Air Defense command (NORAD). Canadian officers often sit in command of NORAD forces. Another significant aspect of the U.S.-Canada relationship is the extensive network of defense production, research, and development agreements. The 1963 Defense Development Sharing Arrangement has allowed Canadian firms to develop defense articles for the U.S. It also establishes Canadian economies of scale in recognition of the interdependent nature of the defense of North America.[11] This arrangement has allowed Canada to take advantage of the large U.S. DTIB—giving them increased access to emerging technologies and the ability to sustain high-technology defense industries. In fact, Canada is considered a "domestic source" for defense contracting, and Pratt and Whitney—a major supplier for fighter engines—is a Canadian-

[8] Ibid.
[9] Minister of Public Works and Government Services, Canada, "1994 White Paper on Defence," *Canadian Minister's Reports,* Chapter 5, n.p.; on-line, Internet, 23 March 2000, available from http://www.dnd.ca/eng/min/reports/94wpaper/five.html.
[10] Ibid.
[11] Ibid.

owned company. Along this line, agreements have been established that mandate a certain percentage of each U.S. defense satellite contract be awarded to Canadian Aerospace firms. In short, Canada has been trusted with some of America's most advanced technology.

Britain. A close second to Canada, in terms of an interdependent relationship, is Britain. America and Britain share a familial bond; many view the beginnings of the American heritage as a birth from Great Britain. Throughout Europe, the Anglo-American alliance is referred to as the "special relationship." American support for Great Britain during both World Wars went far to create an intimate defense relationship. From sharing warships, bombers, and ULTRA (Great Britain's intelligence penetration of encrypted German communications) in WW II to sharing nuclear missiles during the Cold War, the "alliance," as Winston Churchill suggested, was made possible by the common interests of the "Anglo-American brotherhood". It was forged by the fire of political necessity, and its strength was such that it defeated the gravest threat that the free world has ever faced.

The A-B-C Countries are a Safe Bet. Any of these three countries would be fine contenders—from a security perspective—for an F-22 transfer and would rate in the "Minimal" or "Low" category of Figure 7's Risk Analysis Matrix. Additionally, these countries could safely purchase the F-22 without creating a destabilizing effect within their region. Their relatively isolated position from potential adversaries along with the special relationship they share with the U.S. would make any transfer appear as a natural product of intimacy and mutual defense interests.

Obviously, the level of interest these countries expressed toward an F-22 purchase would play a central role in a transfer decision. However, if for nothing more than the symbolic function and the diplomatic good will, it is important that the U.S. *offer* these countries the opportunity to acquire the F-22. The offer alone would go a long way in affirming mutual trust, shared values, and cooperative strategic interests between the governments.

In April 2000, the Clinton Administration announced it would give special export status under the ITAR to both the UK and Australia—this would exempt these two

countries from most arms-export controls. This move would put these countries on par with Canada, currently the only country to enjoy this level of ITAR status.[12]

Currently, only the Australians have expressed an interest in purchasing the fighter.[13] The prospects for a Canadian F-22 buy is slim-to-nil as their defense budget has dwindled to nearly one percent of their GNP. Britain, on the other hand, plans to meet its air superiority needs with the indigenously produced Eurofighter. Even though prospects for two of the three countries to actually purchase the F-22 are remote, the offer may also pave the way for future contract support, such as replacement part production, test and evaluation, etc..

Indeed, the A-B-C countries are probably a safe bet for an F-22 export, but the decision maker must look beyond the more obvious solution. If for nothing else, the earlier discussion revealed that pragmatic and ad hoc politics often push export decisions beyond the conservative solution. This point was not lost on the DOD as they have directed Lockheed Martin to study a second-tier, F-22 B-configuration export variant for other countries considered close friends of the U.S. Even if it is determined that the degree of sophistication and level of technology contained in the F-22 B configuration is still too sensitive for release to these countries today, intellectual effort in this direction will pay dividends when similar issues are raised with the JSF later

"What About Israel?"

Undoubtedly, any export of the F-22 will raise the question, "what about Israel?" Much like the “ABC” countries, U.S.-Israeli relations are also very close, so much so, that the U.S. has risked a nuclear confrontation with the Soviet Union in the past to provide military support to Israel. President Reagan considered Israel a “strategic asset” because of its anti-USSR stance. Israel's military and intelligence capabilities, along with its strategic location, were viewed as a critical element in containing Soviet expansion in the region. There is much popular support for Israel—partly from the large population of U.S. Jews and the Christian community, and partly from Americans in general who

[12] Bryan Bender, “USA to Give Special Export Status to UK and Australia,” *Jane’s Defense Weekly*, 19 April 2000, *Jane’s Online*, on-line, Internet, 12 May 2000, available from http://www.janes.com.
[13] Charles Buzze, F-22 Advanced Product Development Manger, Lockheed Martin Aeronautical Systems, Marietta, GA. Interviewed by author, 4 February 2000.

identify with Israeli ideals of democracy, humanitarian values, and their fiercely independent and innovative spirit.

For the first two decades of Israel's independence, the U.S. was reluctant to supply them with significant amounts of either financial or military aid. U.S. policy for denying arms to Israel was based on the following arguments: Israel had access to arms from other sources; concerns over encouraging an arms race in the Middle East (specifically that the Arabs might be compelled to purchase arms from the Russians and Chinese); and that military aid to Israel would alienate the Arabs. [14] The major turning point in the U.S.-Israeli relationship occurred after President Lyndon Johnson's decision to sell F-4 Phantoms to Israel in 1968. Then Assistant Secretary of Defense, Paul Warnke, explained the significance of the sale as a departure from the long-standing policy of denying high-tech weapons to Israel in an effort to reduce the risk of a confrontation with the Soviet Union in the Middle East. He went on to say that such a policy was no longer viable because the Europeans—especially the French—continued to pump arms into Israel. "*We will henceforth become the principal arms supplier to Israel*, involving us even more intimately with Israel's security situation and involving more directly the security of the United States" [emphasis added].[15]

However, a behind-the-scenes actor played a large part in affecting the policy change. This was the Israeli lobby. As President Johnson once complained, "never in all the years of political life did [I] have such political pressure—Jewish groups and congressional pressures."[16] This political lobby is still very active and influential today.

The end of the Cold War, along with the dissolution of the Soviet threat in the Middle East, has changed U.S.-Israeli security relations. Israel no longer has a role in thwarting Soviet aggression in the region. Alleged Israeli security violations have also raised serious questions about U.S.-Israeli security cooperation. The Washington Times reported in March 1992 that the Bush Administration was investigating an alleged Israeli transfer of U.S. Patriot missile technology to China without its approval. During this

[14] Mitchell G. Bard, "The 1968 Sale of Phantom Jets to Israel," *The Jewish Student Online Research Center* (The American-Israeli Cooperative Enterprise, 1999), n.p.; on-line, Internet, 23 March 2000, available from http://www.us-israel.org/jsource/US-Israel/phantom.html.
[15] Ibid.
[16] Ibid.

time, the Wall Street Journal reported that the State Department and U.S. intelligence agencies had been investigating unauthorized Israeli technology transfers to China, South Africa, Ethiopia, Chile, and other countries.[17]

Mutual trust between the two nations has also been strained by Israel's tendency to act unilaterally and outside the provisions granted by the Arms Export Control Act and the Mutual Defense Assistance Agreement. The Secretary of State has reported to Congress on four such occasions:

- On April 5, 1978, after Israel invaded Lebanon;
- On August 6, 1979, after a series of Israeli raids into south Lebanon;
- On June 10, 1981, after Israel bombed the Iraqi Osirak nuclear reactor (using U.S.-acquired F-16s);
- On July 1982, after the Israeli invasion of Lebanon.[18]

Another area of strain in U.S.-Israeli security cooperation involves Israel's transfer of U.S. arms to third countries without U.S. permission. Israel has sold spare parts to Iran and larger items to Argentina. The U.S. also blocked their attempted sale of 24 Kfirs to Ecuador in the late 1970s as the U.S. was trying to avoid an arms race in Latin America (see Chapter 2 for details). The U.S. was able to do this because the Kfir used U.S. General Electric J-79 jet engines. However, this led the Ecuadorians to a $260 million deal with the French for 24 Mirage F-1 fighters.[19] Ironically, years later the Peruvians would purchase the Mirage 2000 to counter the threat posed by the Ecuadorian Mirages.[20]

U.S. concerns over Israeli arms sales have resurfaced recently when the Israelis began installing their Phalcon radar system in a Russian-built A-50 AWACS for the Chinese. According to *Aviation Week and Space Technology*, "the Administration is so angry they have approved the sale of AWACS aircraft to Turkey, but not to Israel, in order to make the point that some U.S. officials no longer trust Israel, as they once did, on

[17] Clyde R. Mark, "82008: Israeli-United States Relations," CRS Issue Brief, 19 December 1996, n.p.: on-line, Internet, 23 March 2000, available from http://www.fas.org/man/crs/82-008.htm.
[18] Ibid.
[19] Eventually, Israel was able to sell Kfirs to Ecuador (1982).
[20] Frank O. Mora and Antonio L. Pala, "US Arms Transfer Policy for Latin America," *Airpower Journal* 13, no. 1 (Spring 1999): 76-93.

technology transfer issues."[21] The Israeli government insisted that no U.S. technology was involved in the sale, but the Pentagon's position was that, given the very close relationship we have, there is always a danger that some of this technology could pass from Israel to China."[22]

U.S.-Israeli relations are also strained over the divergent viewpoints regarding the overall concept of arms assistance in the Middle East. Where the U.S. views its role as a "fair broker" to the Middle Eastern countries, Israel contends they should have a unilateral arms trade advantage for security reasons. For example, in 1990 the U.S. considered bolstering arms transfers to Saudi Arabia in light of the Iraqi threat. Israel, in turn, requested increased compensation. Israel requested Patriot missiles, more F-15s, Apache helicopters, access to U.S. satellite intelligence, and an increase in the U.S. weapons stockpile in Israel, to which the Israelis would have access.[23]

Understandably, Israel views the world from the lens of realism, as adversaries who have vowed destruction surround it. The Israelis' security concerns are so immediate, that they believe they must do whatever it takes to survive. For them, it is more practical to ask for forgiveness from the U.S. than to ask for permission.

With respect to the F-22, an export decision to Israel does not look favorable, at least from a purely rational perspective. There appears to be enough evidence that Israel has independently brokered U.S. technology to third-party counties in order to gain security advantages for itself. Additionally, any unilateral advantage to the Israelis will be perceived to upset the balance of power in the region and would represent a destabilizing move on the part of the U.S. If the U.S. is willing to release the F-22 to Israel, it must also consider a reciprocating transfer to the Arabs, such as Saudi Arabia, the UAE, or other Arab states that could afford the purchase. Obviously, NATO would have been "slighted" in the event, and an F-22 export to select NATO members would have to be

[21] David A. Fulghum, "Israelis Propose New Intelligence Aircraft," *Aviation Week and Space Technology* 152, no. 15 (10 April 2000): 70.
[22] Lee Myers, "U.S. Seeks to Curb Israeli Arms Sales to China," *The New York Times*, 11 November 1999; *New York Times Online*, on-line, Internet, 12 May 2000, available from http://www.nytimes.com/library/world/global/111199israel-china.html.
[23] Ibid.

considered. Figure 6 represents the major F-22 export decision elements weighted against a favorable transfer.

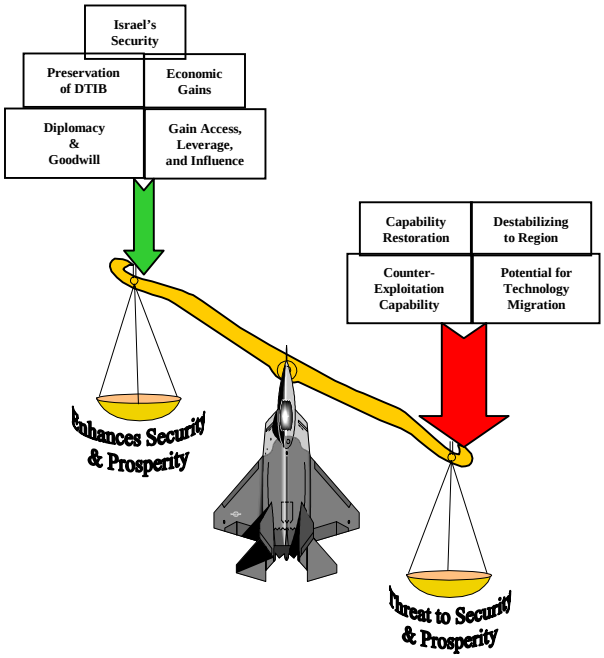

Figure 6. Israeli Export Decision Elements

It should be noted that the evidence against an Israeli export is weighed solely from a practical and rational perspective. With Israel, one must keep in mind that rationality and practicality are not always the central issue. There are several issues beyond the security of U.S. national interests that enter into the Israeli F-22 export debate. First, Israel wants the F-22. In April 2000, Israel was in the beginning stages of negotiations for 50 F-22s for delivery in the 2006-7 timeframe.[24] They perceive a growing threat from Iran and Iraq as these countries continue to push forward with their weapons-of-mass-destruction programs and long-range ballistic-missile development. Second, Israel feels that since the UAE was granted the Block 60 F-16, they are in a good position to ask for the F-22. Finally, one must not forget that one of the most influential voices on Capitol Hill is the Israeli lobby—policy can change with the stroke of a pen. See Figure 7.

[24] David A. Fulghum, "Israelis Propose New Intelligence Aircraft," 64.

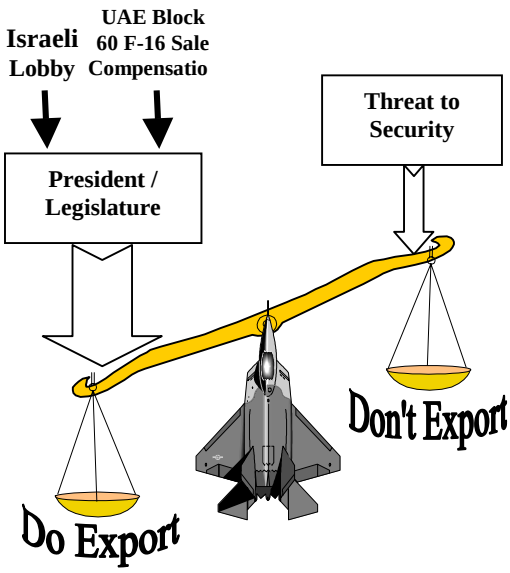

Figure 7. External Influences on an Israeli F-22 Transfer Decision

It is conceivable that a presidential- or legislative-level decision could be made to export the F-22 to Israel. This may have important implications for exploitation protection measures currently under development. The "Tier-2" F-22 configuration B export design now takes on greater significance—potentially serving as a reasonable hedge against a possible Israeli export mandate. The Defense Department, LOEXCOM, and the contractor must consider an F-22 transfer as a distinct possibility and should address Israeli-specific technology protection measures and capability reduction issues—that is assuming the F-22 gets any kind of export approval.

As mentioned above, it also follows that if Israel were to be successful in their bid for the F-22, several other close allies of the U.S. warrant further consideration. When contemplating an export decision beyond the U.S.'s closest allies, technology protection becomes a central concern. Ultimately, the level of protection afforded by the F-22 configuration B and the confidence of the decision maker in the security of U.S. technologies will be a primary factor in any export decision. Only those directly involved with F-22 export issues will have access to the necessary details required to make a rational decision as to whom an F-22 configuration B-type variant could be sold. It is possible, however, to present the decision maker with a menu of "most likely" candidates and some of the key decision elements associated with exporting to these countries.

Saudi Arabia

If Israel were to be approved the sale of the F-22, the U.S. role of a "fair broker" would be called into question if a compensatory offer were not made to the Arabs. Saudi Arabia has historically been the U.S.'s natural choice for balancing against Israeli arms deals. The Saudis, over the long-term, have proven to be a fairly reliable and trustworthy ally. The U.S.-Saudi military-to-military relationship represents the largest foreign military sales program in the world. Much of the U.S. willingness to export arms to the Saudis stems from their advantageous position regarding oil. They have the world's largest reserves and are the largest exporter of petroleum and play the leading role in OPEC. Security of the oilfields and the desire to amplify the U.S. voice in OPEC have largely driven U.S. military export decisions. For example, in the early '80s the U.S. granted Saudi Arabia the sale of AWACS, arguing that it strengthened the U.S. position in the region and added to regional stability. For these reasons, the Reagan Administration also argued that such a deal was also beneficial to Israel. This view was not accepted by the Israelis who tended to see Washington as appeasing the Saudis and that any improvement in U.S.-Saudi relations would come at the expense of Israel. Hence, Saudi deals are typically counterbalanced by compensatory Israeli deals and vice versa.

Unlike the Israelis, however, the Saudis do not have a developed aircraft industry, nor do they export advanced air technologies. It follows that the propensity to exploit any F-22 technologies would be minimal. Perhaps the biggest threat to technological security would be the potential for intermingling of the F-22 program with the British aerospace industry, which has a significant influence within the Saudi Air Force.

Saudi Arabia's support of U.S. actions in the Gulf has also strengthened U.S.-Saudi relations. Since the war, the Saudis have reluctantly allowed a U.S. presence in their country. The U.S. strongly desires a presence in this region and access to forward basing. This puts the Saudis in an advantageous position for requesting the F-22 with basing rights as a carrot for a favorable export decision. The Saudis' track record with both the AWACS and the F-15 also work to their favor. During the Gulf War, Saudi AWACS contributed to the defense of the area and controlled coalition strikes against Iraq. Saudi F-15s were also successful in intercepting and destroying Iraqi aircraft.

There are also significant negative elements weighing against a Saudi F-22 decision, however. An argument can be made that such a move would be risky because Saudi security, stability, and friendship may be questionable. Currently, the ruling Saudi regime is on shaky ground. Economic underdevelopment has given rise to militant Islamic and anti-Western sentiment, as demonstrated by the 1996 Kohbar Towers bombing. Intermixing a high-tech transfer with the potentially fragile regime might encourage a situation similar to that which ensued from the Shah's overthrow. The collapse of this regime would more than likely spell the end of basing rights in Saudi Arabia, which are critical for dealing with Gulf-area crises. An F-22 sale would also agitate U.S.-Israeli and Saudi-Israeli relations. A long-range, high-altitude, high-speed, stealth multi-role fighter would be a significant concern to a small nation such as Israel, especially since this would pose a direct threat to its prized air defense network. It can also be expected that the Israeli lobby would aggressively attack any legislation recommending such a sale—regardless of whether Israelis were granted their own F-22 purchase. It is also reasonable to assume that any thoughts of a Saudi Arabian deal must first be preceded by an Israeli offer.

Japan

The cornerstones of the U.S.-Japan relationship are intertwined economies and a bi-lateral security treaty. The trade relationship between the two countries is significant in that it represents the world's two largest and most interdependent economies. Since 1952, the two countries have maintained a security alliance which anchors Japanese-U.S. policies in the Asia-Pacific region. Most Japanese support the U.S.-Japan security treaty and believe that the alliance is in the best interest of both countries. It allows Japan to continue to limit its military capabilities to those required for strictly defensive purposes and to maintain its non-aggression policy in the region. It also allows the U.S. to maintain its bases in Japan for the purposes of protecting Japan and projecting power within the Asia-Pacific region where its trade and economic interests are continually growing.

Japan relies on the U.S. security commitment as one of two pillars for Japanese defense. The second pillar is comprised of its self-defense capabilities, which remain

constrained by political and financial considerations as well as by public opinion. Recently, Japan began to re-evaluate its current defense policy under the realization that the U.S. may have lost interest in its strategic guardianship role with Japan, as the need for containment of Soviet aggression no longer exists and U.S.-Japanese economic interests continue to diverge. Japan has also emerged as a significant power, with political and military interests that derive from their own national concerns. As a result, common geopolitical interests with the U.S. have declined.[25] Several recent incidents have caused a debate over expanding the constitutional role of the Japanese Self Defense Forces (JSDF). Japan has felt hamstrung by Article 9 of their (U.S. imposed) constitution which limits their response options for dealing with issues such as the 1996 hostage crisis at the Japanese Embassy in Peru, the 1998 North Korean ballistic missile tests in Japanese waters, and the clash in East Timor, which brought Asian nations into action.[26]

Currently, Japan keeps its defense spending below one percent of its GNP (though this is a large amount given the size of Japan's economy). Within this budget, the Japanese Air Force is currently procuring the F-2 fighter which will dominate its aircraft procurement budget through 2003. The air force completed its F-15 buy in 1996 and replacement or refurbishment of this aircraft is another budget decision awaiting the Japanese Defense Agency.

An F-22 purchase may be an attractive replacement option for the aging F-15s, especially if the role of the JASDF expands. Financially, the Japanese would have no trouble affording the aircraft and their purchase would increase the volume of production and thereby decrease the cost per unit. This would represent a savings for the U.S. in reduced purchase price and cost sharing of maintenance, spare parts, and upgrades over the life of the aircraft. Japan's strategic location and its relative importance to America could also be argued as a reason for supplying them with the best air defense fighter in the world. The F-22's ability to datalink with AWACS (Japan has its own E-767 variant), and its increased performance in intercepting high, fast-flying aircraft would all be attractive reasons for upgrading Japan's air defense fleet.

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[25] "Japan is Rising from its Pacifism," *Global Intelligence Update*, 25 January 2000, n.p.; on-line, Internet, 17 May 2000, available from http://www.stratfor.com/asia/commentary/m0001250135.htm.
[26] Ibid.

On the negative side of a potential Japanese F-22 export proposal are several elements ranging from regional stability to technology exploitation. First, the stealth and long range qualities of the F-22 would certainly raise eyebrows in the region as well as among Japanese pacifists as to why Japan was acquiring an inherently offensive weapon. Such a deal would certainly not stand well with the Koreans who still harbor animosity toward the Japanese for their brutal occupation during World War II. In fact, Japan's acquisition of the E-767 raised some concern in South Korea. From their perspective, the AWACS' long-range detection capability represented a more offensive posture on the part of Japan. Unable to afford these aircraft themselves, the Republic of Korea (ROK) became interested in a 737-700 with the "MESA" radar, the same configuration Australia is purchasing under its "Wedgetail" program (a lower cost Airborne Early Warning and Control system derivative). Nonetheless, the AWACS issue highlights the security dilemma that would be exacerbated by any unilateral F-22 export to Japan. The second element working against the sale is Japan's expressed interest in replacing their F-15s with an indigenously produced fighter. A U.S.-Japanese coproduction of the F-22 through offset agreements may surface as an attractive compromise. However, from a technological standpoint, this would be a dangerous prospect that could threaten national security. According to Lockheed Martin, the most closely guarded secrets with the F-22 involve the manufacturing and production techniques as well as the advanced materials used for building the aircraft. Additionally, the Japanese track record for guarding close-held dual-use secrets was tarnished in 1987 with the alleged sale of "submarine-quieting" technology to the Soviet Union by the Toshiba Corporation in violation of Western export controls. The third detractor of a Japanese F-22 deal would be the potential compensatory demands from either Taiwan or South Korea. Though both these countries have significant security concerns, they also would pose a risk to the security of the F-22 should such consideration be given (if for no reason other than their close proximity to the adversary). Compensatory exports to Taiwan and South Korea also could potentially destabilize the Asian-Pacific region and would certainly hinder U.S.-China relations.

Turkey (and other NATO Countries)

Though a dark horse, Turkey could make a compelling case for acquiring the F-22. There are three primary factors that play favorably for Turkey. First is their geostrategic position. Turkey is located at a point where Europe and Asia meet. This unique geographical position allows airpower access to European, Balkan, Middle Eastern, Caucasian, Mediterranean, and Black Sea regions. This unique location gives Turkey tremendous leverage over the U.S. through basing rights. The U.S. is able to influence activities in northern Iraq by using its advantageous forward position in Turkey. This also proved to be very useful during the Gulf War. Second, Turkey is a member of NATO, and its membership in the Alliance constitutes its primary foreign and security policy interface with the U.S. As part of NATO, it is entitled to increased access to front-line U.S. military equipment. Third, Turkey's NATO rival, Greece has agreed to buy Eurofighter Typhoons—Ankara may look to the F-22 as a one-up counterbalance to this potential threat.

Though Turkey currently appears to be more interested in the JSF as a follow-on fighter, any cancellation or program slips may make the F-22 an attractive alternative. This would also have certain benefits for the U.S.—especially if there are delays with JSF—as a means of securing a portion of the NATO fighter market currently being threatened by the Eurofighter (though the Block 60 F-16 may soon become the NATO fighter of choice, even over the JSF). Arguing along the same lines, one could also make a persuasive argument for other core NATO countries such as the Netherlands or Norway, that are not yet wedded to the Eurofighter or Rafale, as serious contenders for the F-22, should the JSF program self-destruct. The prudent decision maker must also consider the concerns that Russia will undoubtedly have with NATO F-22 air defense-penetrating fighters arrayed around its borders.

Turkey’s solid relationship with Israel and their mutual strategic efforts to keep Syria in check also weigh favorably for export status from the United States. Should Israel be granted the F-22, Turkey may be compelled to pursue a similar deal in an attempt to offset the balance of power, maintain an equal international status, and facilitate Turkish-Israeli cooperation in air combat training which occurs inside Turkey's borders.

Turkey's secular-government ideology is another favorable element in U.S.-Turkey relations. The majority of Turkey's population, however, practices Islam and there is concern that the Turkish government may fall victim to a Fundamentalist movement much like Iran in the 1970s.

Another obvious disadvantage to a Turkish F-22 deal would be its destabilizing effect with Greece. Their long-standing feud over who controls what in the Aegean could be further exacerbated by any unilateral deal. Turkey's ongoing problem with terrorism could also be construed as another reason why it may not be wise to offer them the F-22. Specifically, the PKK (the rebel Kurdistan Workers Party), an internationally recognized terrorist organization, seeks to create a separate Marxist-Leninist state within Turkey's borders. This group has been known to raid villages and sabotage Turkish economic development projects and could pose an additional threat to F-22 security. Though a peaceful solution may be near, a new problem of what to do with the nearly 70,000 pro-Turkish Kurds who have been hired as village-guards over the last 15 years of fighting may become a new destabilizing issue. Turkey's government is struggling with how to trim the guard without releasing tens of thousands of frustrated, well-trained fighters on the streets in the Southeast, where unemployment in some areas reaches 50 percent.[27]

Oil issues are also placing strain on U.S. relationships with Turkey. U.S. oil companies have revived interest in a plan to construct an oil pipeline from Bulgaria to Albania. The trans-Balkan pipeline routing would circumvent Turkey. Though this pipeline is economically advantageous for the U.S., pursuit of this project contradicts previous policies which supported the development of a Baku-Ceyhan oil pipeline from Azerbaijan to a Mediterranean port in southern Turkey. This change of interests could injure carefully cultivated relationships with Turkey, who views the Baku-Ceyhan line as a significant economic benefit.[28] Oil investors, however, are skeptical about this pipeline as it transits undeveloped territory, with little pre-existing infrastructure to support construction and operation, and worry about the potential resurgence of Kurdish violence.

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[27] Selcan Hacaoglu, "Turkish Militias' Future Cloudy as War With Rebels Winds Down," *Washington Times*, 10 May 2000, 15.

[28] "Trans-Balkan Pipeline Complicates U.S.-Turkey Relations," *Global Intelligence Update*, 14 January 2000, n.p.; on-line, Internet, 17 May 2000, available from http://www.stratfor.com/SERVICES/GIU/011400.ASP+Turkey+pipeline&hl=en.

Also, there are environmental concerns over transporting oil through Turkey's Bosporus Strait. The trans-Balkan pipeline avoids these problems, bolsters the U.S. relationship with the Caucasus, and opens a route for oil to flow directly to Western Europe. Depending on how the pipeline issue plays out, an F-22 offer may help mitigate U.S.-Turkey tensions. On the other hand, tensions may become so high that an F-22 deal would be out of the question.

Turkey's indigenous fighter aircraft industry must also be considered as a potential threat to technology exploitation. More than likely, the threat would not be significant as its industry is focused more on the *assembly* of prefabricated components rather than on the technology itself.

Second-tier country conclusions. In short, the level of technology protection built into the F-22 and the decision maker's confidence in it will be primary drivers for any second-tier-country export decision. Only a brief sketch was given for some of the most likely F-22 configuration B contenders. Should an export decision beyond the A-B-C countries be seriously entertained, it would behoove the decision maker to carefully identify and weigh all the decision elements in a systematic manner. The bottom line is that any F-22 export deal considered must—in the end—enhance U.S. national security.

Conclusions

If nothing else, it is my hope that this paper has illuminated some of the complex and often hidden issues behind crafting a high-tech air-export decision. It requires more thought than merely agreeing to sell second-rate surplus to trusty U.S. allies. On the other hand, decision makers must be careful not to let domestic and international market forces or the plea to preserve and advance the DITB to railroad air-export policy—it must be a holistic and subjective process, which spans the entire spectrum of domestic and international security considerations. An F-22 export decision brings challenging security and regional stability issues. "Answering the mail" on these issues now will make future high-tech air-export decisions, such as those that will most assuredly be raised with the JSF, easier later on. We have a complex, and perhaps laborious, export control system in place that provides adequate technology and capability protection oversight. It is comprised, however, of many different agencies and offices whose perspective may be

parochial. Insightful senior decision makers must capture the various perspectives, measure their significance, and debate them in the context of national security. I hope this discussion will help them frame that debate.

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