

Paradigms of Development and Employment of Weapon Systems

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Abstract

Weapons procurement decisions are extremely complex, with an unmanageable quantity of variables to take into account. The human brain, unable to process such a complex problem in a strictly rational way, seeks mechanisms to bound the problem and therefore simplify it. One way this occurs is through the development of paradigms, or common viewpoints held by decision makers that incorporate the irrational, emotional, and qualitative experience and knowledge, as well as quantitative knowledge such as analysis and test results. A paradigm in use by decision makers in the U.S. Air Force is the propensity to buy weapons developed and produced in America. This study traces the origins of this paradigm, and how it evolved over time. Drawing on examples from recent history it identifies the sources of the paradigm which are: a need to maintain the nation's technological base, the inadequacy of foreign weaponry to meet U.S. needs, the fact that the U.S. economy is able to support a strong defense industry, the ability to advance its policies by transfer of weapons to allies, the desire to share standardized equipment with allies, and the desire to gain the economic benefits from being an exporter of weapons. It concludes that existing paradigms influence what weapon systems the U.S. will procure, and that in turn affects the strategy the nation employs. Relating the paradigm of American-made weapons procurement to the cases of the F-35 fighter and the recently cancelled Air Force tanker program, it asks questions about the future of weapons procurement choices in a global defense environment.

Paradigms of Development and Employment of Weapon Systems

1.0. Introduction

Military leaders are faced with extremely varied and complex choices of weapon systems when making national security decisions. These decisions are further complicated because they often include options for systems that are not mature enough to satisfy questions of feasibility, cost, and effectiveness. When one considers all of the variables involved in the process, it becomes apparent that it is beyond human capacity to optimize decision-making in this environment.

During the last century global security dependencies and alliances have greatly increased. This shift in the global security environment has added an increased level of complexity to weapon systems procurement decisions. Whereas in the past a nation's primary concern was to decide which systems best served its military needs, increasingly intertwined political and economic relationships now demand that weapons choices satisfy constraints imposed by other nations as well.

Modern warfare, especially in a global setting, is heavily dependent on technology. It follows, then, that national strategy in warfare is only as good as the technology available to implement it. Recognizing that technology and strategy are intimately related, this study seeks to shed light on decision-making during the process situated at the intersection of technology and strategy; namely weapon systems procurement. It focuses on the influences of globalization on that process, and the resulting relationship of technological systems and national strategy.

The approach to this topic was to determine some of the factors that affect weapons procurement decisions. In order to understand the decision environment that exists today, historical research methods were used to ascertain how decisions were made in the past and how the current situation evolved. This approach allows the research to consider decisions about mature systems which are unencumbered by security, legal, or political constraints that could prevent access to relevant information. It also allows the consideration of systems for which the outcome of the decisions is known. Some analysis as well as the conclusions will apply the historical data to current situations.

Limitations to this research arise from the fact that historical data is perishable and selective. A study of history can only utilize that data which survives, and only then in the condition in which someone chose to record it. Because this study attempts to understand the thought process of decision makers, it is more challenging, since thoughts can only be inferred from other sources. Notwithstanding these limitations, there is much data from which useful conclusions can be drawn.

2.0. Foundations and Theory

Volumes have been written on numerous related topics including military acquisition, requirements generation, decision theory, technology and society, and innovation. This study necessarily builds on existing knowledge and theories in order to reach conclusions about how procurement decisions are made, and how globalization affects them.

2.1. Military Acquisition and Requirements

Given the perpetual problems with the military acquisition process it has been well studied at all levels of academia and government. Recommendations from these

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studies range anywhere from managing acquisition personnel,¹ changing the scheduling process,² and changing the culture to enable reform implementation,³ to more sweeping proposals. McKinney, et al. have documented the recommendations of those studies commissioned directly by the President or Congress aimed at system-wide reform.⁴ They conclude that problems with the acquisition process fall into a few general categories related to the excessive cost of systems, the failure to meet program schedules, and the inability of systems to achieve the expected performance. While relevant, these studies focus more on the management of programs after they are in place, and not as much on the very early stages when the need for a system is being determined. Needs determination is at the heart of the intersection of technology and strategy.

Under the umbrella of military acquisition there is a specific process for the generation of requirements. This process has also commanded great attention and incited numerous studies. Recent examples include a comparison between the Air Force process and best practices in industry and other services;⁵ an exploration of improving weapon systems outcomes by expanding the requirements generation process to include maintainability requirements, and not only technical performance requirements;⁶ and efforts to capture unarticulated requirements, such as the need for flexibility or robustness.⁷ While they address such tangible aspects as organizations and people involved, or steps to be taken during the process, most of the recommendations aimed at improving the requirements generation process have fallen short.

A Joint Staff memo entitled “Changes to the Requirements Generation System”, released on 7 October, 2002, stated, “The [then] current process frequently produces stovepiped solutions that are not necessarily based on the future capabilities required by the joint warfighter.”⁸ Soon after this memo was written a new set of joint instructions was released introducing the Joint Capabilities Integration and Development System (JCIDS), a requirements generation process that focuses on required capabilities, instead of required systems.⁹ Despite the extensive changes that have been implemented, some acquisition professionals remain very convinced that results will continue to be

¹ See for example, Forseth, C.E., Major, USAF, *The Pursuit of Acquisition Intrapreneurs*. 2002, Massachusetts Institute of Technology: Cambridge, MA. p. 21.

² See for example, McNutt, R., *Reducing DoD Product Development Time: The Role of the Schedule Development Process*, in *ESD*. 1998, Massachusetts Institute of Technology: Cambridge, MA. p. 443.

³ See for example, Doane, D.R., *Cultural Analysis Case Study: Implementation of Acquisition Reform within the Department of Defense*, in *ESD*. 1997, Massachusetts Institute of Technology: Cambridge, MA. p. 101.

⁴ McKinney, E., E. Gholz, and H.M. Sapolsky, *Acquisition reform — Lean 94-03*. 1994, Massachusetts Institute of Technology: Cambridge, MA. p. 44.

⁵ Wirthlin, J.R., *Best Practices in User Needs/Requirements Generation*, in *ESD*. 2000, Massachusetts Institute of Technology: Cambridge, MA. p. 299.

⁶ (GAO), G.A.O., *Best Practices: Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs*. 2003, GAO: Washington, D.C. p. 71.

⁷ Ross, A.M., *Managing Unarticulated Value: Changeability in Multi-Attribute Tradespace Exploration*, in *Engineering Systems Division*. 2006, Massachusetts Institute of Technology: Cambridge, MA. p. 361.

⁸ Hawkins, Maj Gen James A., vice director, Joint Staff. Memorandum, DJSM-0921-02. Subject: Changes to the Requirements Generation System, 7 October 2002.

⁹ CJCSI 3170.01, *Joint Capabilities Integration and Development System*, Chairman of the Joint Chiefs of Staff. 2005, Department of Defense: Washington, D.C. p. 62.

comparable to those under the old system.¹⁰ If the documented requirements process begins with “stovepiped solutions”, the decisions made prior to that process beginning are those that are concerned with the broad selection of weapon systems, and therefore relate new technologies to strategy.

2.2. Decision Making, STS, and Innovation Theory

When studying the decision making process there is an insurmountable body of literature to consider.¹¹ Narrowing the topic is therefore necessary, especially since this study is concerned with technology and strategy more than with the intricate workings of the mind. Higher level ideas within this field should therefore be adequate to aid in learning about weapon systems decisions.

Herbert Simon proposed that humans are not strictly rational beings, and in fact cannot be because of the complexity of the situations in which they are required to make decisions.¹² Instead, he argues that they are only partly rational, with the other part being made up by emotional and irrational inputs. Humans employ heuristics, narrowing down the possibilities until a rational decision can be made. The limitations of the human capacity to make rational technology and procurement decisions in this very complex environment manifest themselves in the various decision making mechanisms they contrive, both conscious and unconscious. Mechanisms such as various forms of analysis, down-selecting of options using grading schemes, and even intuition or “gut feel” based on years of experience can all play a role.

One method of implementing heuristics is by viewing a complex situation through the lens of an established paradigm. Thomas Kuhn introduced this concept in the field of knowledge when he argued that scientists hold certain common viewpoints regarding their areas of study.¹³ These “paradigms” provide a way of thinking about a given field of study that explains all accepted knowledge to date, and helps guide scientists to further knowledge. There are times when newly discovered knowledge does not fit the paradigm, and the paradigm must be stretched. If the paradigm ultimately cannot explain the new discovery it must be altered or abandoned in favor of a new paradigm. This view of knowledge progression can be applied to military strategy to help understand how decisions are made.

This model suggests that human knowledge is not absolute; a concept which is more readily accepted for military strategy than for science. However, even scientific knowledge is subject to human evaluation. Bruno Latour argues that before scientific or technological knowledge is accepted as true, those proposing it must convince enough other people, largely through social processes, that it is true.¹⁴ Everything from foundational assumptions, to experimental equipment, to presentation of results is suspect until enough people are convinced that the proposed knowledge is true. This process is

¹⁰ Interview with Charles E. “Chuck” Myers, Gordonsville, VA, April 28, 2008; and Telephone interview with Major General Glenn Kent, USAF (Retired), June 9, 2008.

¹¹ A Google Scholar search of the entry “decision theory” returned over 2.5 million references.

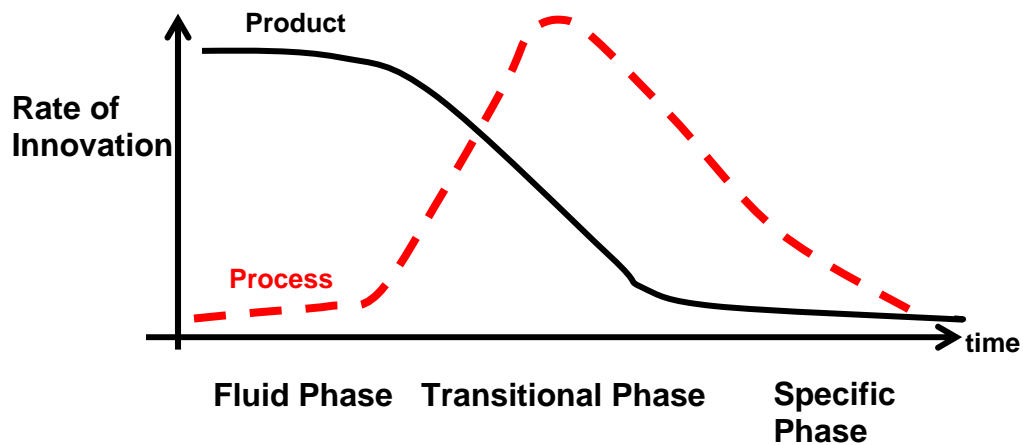
¹² Simon, H.A., *Models of My Life*. 1996, Cambridge, MA: MIT Press. 415.

¹³ Kuhn, T.S., *The Structure of Scientific Revolutions*. Third ed. 1996, Chicago: The University of Chicago Press. 212.

¹⁴ Latour, B., *Science in Action: How to Follow Scientists and Engineers through Society*. 1987, Cambridge, MA: Harvard University Press. 274.

even more applicable to military strategy, and related procurement decisions, which are not an exact science.

Abernathy and Utterback introduced the “dynamics of innovation model” which can be used to help visualize and understand the creation of ideas in the field of product development.¹⁵ It can also be adapted to military strategy. According to the model there are roughly three stages that innovative products go through: the fluid phase, the transitional phase, and the specific phase. The fluid phase occurs when a new innovation emerges, and there is a lot of activity around determining the best way to develop and use it. During the transitional phase the market settles on a standard, or “dominant design”, and product innovation slows, while process innovation ramps up, as competitors strive for the ability to design and produce the product more efficiently. During this phase many of the competitors and designs drop out. In the third phase, the specific phase, both product and process innovation dwindle, as surviving firms make incremental improvements focused on improving cost, volume, and capacity. This model can be illustrated in graphical form:



The dynamics of product innovation (Adapted from Utterback, xvii.)

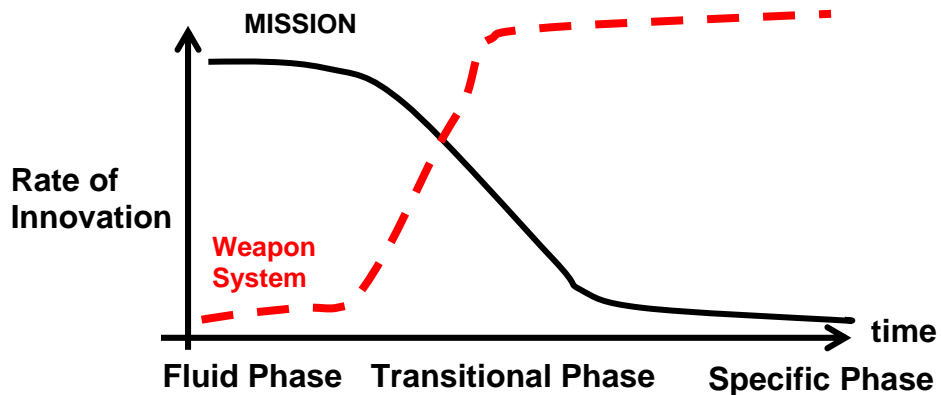
2.3. Applying Theory to Military Missions

The theory presented, through adaptation, can aid in understanding the decision making process related to the procurement of weapons for military missions. As previously established, decision makers are forced to make important decisions based on an enormous amount of information, which even if it were possible to assimilate, would still be incomplete. As a result, they seek ways, either consciously or unconsciously to bound the problem.

¹⁵ Utterback, J.M., *Mastering the Dynamics of Innovation*. 1994, Cambridge, MA: Harvard Business School Press. 253.

One of the main assets of decision makers is experience, often in combat, which is traditionally valued above almost any other asset.¹⁶ The paradigm model provides a way of explaining a mechanism by which decisions are made, based on the prior experiences of the decision makers. Encapsulated in the paradigm are the lessons learned, the beliefs, the opinions, the biases, and the numerous irrational components used to bound the complex decisions that must be made. Of course it can also encompass many of the rational factors, such as quantitative analysis, tradeoff studies, test results, etc. Just as in scientific discovery, when formulating military strategy and making related procurement decisions, a paradigm can be used to explain existing data and project beyond known limits. If newly acquired data cannot be explained by the existing paradigm, the paradigm must be altered or discarded in favor of a new one that can explain the new data.

The creation of a new paradigm can be modeled in much the same way as a new product idea, since both are innovations. Visually such an adaptation can be represented similar to the Abernathy and Utterback graph as follows:



The dynamics of mission innovation

In this model, the innovation refers to the way the weapon system is employed, depicted as “MISSION” on the graph. As can be seen, when a new way of employing a weapon, or new military mission, is conceived, the rate of innovation is high. For example, when aircraft were first used in aerial combat (defined as close-in aerial combat, not aerial intercept such as is accomplished with air-to-air missiles) in World War I strategy and tactics were quite simple. Pilots quickly learned maneuvers that could enable them to get behind the enemy in a position to shoot him down. Innovations in the aerial combat mission came quickly. Once the mission was established fewer innovations were made, such that aerial combat at the end of World War II was quite similar to that at the end of World War I, with allowances for improved weapon systems; aircraft in this case.

¹⁶ Worden, M., *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982*. 1998, Maxwell AFB, AL: Air University Press. See for example p. 190, however this is a theme throughout the book.

As the mission becomes established more clearly, the rate of innovation applied to the weapon system being employed for the mission (depicted by the dashed line on the graph) increases. Unlike the rate of innovation of the processes in the Abernathy and Utterback model, weapon system innovation does not decline. For example, although the aerial combat mission has remained fairly stable, with a decreasing number of major innovations, the advancement in aircraft technology has increased almost exponentially. Fighters made of exotic metals and advanced composites, with advanced computer aided gunsights and afterburning jet engines still perform aerial combat maneuvers developed in World War I.

When the time comes that an established mission no longer fits the existing data, or in this case the factors that made that mission necessary, the mission must be altered to adapt to the new factors, or abandoned in favor of a new mission. For example, the stationary aerial observation mission, performed by manned hydrogen and helium balloons, became too vulnerable and less effective as war was mechanized and the battlefield became more mobile. It was therefore discontinued in favor of aircraft, and later satellite reconnaissance. In each case a new curve could be used to illustrate the rates of innovation.

2.4. Characteristics of a Paradigm

A paradigm, as explained above, is an intellectual tool to help gain insight into the decision making process. As such it does not have to meet a rigid or complete set of criteria. Nor does any organization consciously set out to establish a paradigm. However, as a tool, a paradigm becomes more useful as the ability to recognize it is increased. Because a paradigm exists in the minds of decision makers it can never be truly measured, but the results of those prevailing thoughts manifest themselves in actions that can act as indicators that help define a paradigm.

Some obvious indicators that can be used to recognize a paradigm are statements made by decision makers. Thoughts must be transformed into words if they are to be accepted and acted upon by others. In procurement activities, where building consensus and support is vital to successfully procuring a new weapon, the dialogue and debate provide indicators for prevailing thought.

Of course the procurement of weapons is a very political activity, and therefore not everything that is said can be taken at face value. Arguments can be used to gain support, but may not be indicative of the actual thought process. For this purpose actions must be observed and correlated with verbal statements. One of the most telling actions is the commitment of funds.

Other sources of indicators of prevailing thought, and therefore paradigm, are official documents. Strategy, doctrine, war plans, and other documents that are used to commit forces can reveal what decision makers' thoughts are regarding those forces.

3.0. A Paradigm of American-Made Weapons Procurement

Recently the U.S. Air Force announced its source selection decision for a \$35 billion contract for up to 179 new aerial tanker aircraft.¹⁷ Its choice of the Northrop Grumman/EADS version of the Airbus A330, a European aircraft, has brought into the

¹⁷ "Tanker Contract Award Announced." [Air Force Print News Today](http://www.af.mil/news/story.asp?storyID=123088392) 29 FEB 2008 1 MAR 2008
<<http://www.af.mil/news/story.asp?storyID=123088392>> .

spotlight a long-held paradigm of the Air Force and its predecessors, which is that it buys American-made weapons. A formal protest to the tanker decision was filed and parts of it were upheld by a Government Accountability Office (GAO) ruling. While the protest centered around the source selection process, and the fairness with which the proposals were judged, controversy regarding the issue of procuring U.S. weapons from foreign countries has appeared in numerous media reports and blogs.¹⁸ Because the employment of weapons depends on which weapons have been procured, which in turn is influenced by the prevailing paradigms, it is important to understand those paradigms.

3.1. The Origins of the American-Made Weapons Procurement Paradigm

To fully understand the paradigm of procuring American-made weapons, it is necessary to look at its origins and see how it has developed over time. While there is a rich history associated with arms procurement in America, dating back to before the revolution, this study will focus on the Air Force and its predecessors, and the procurement of aircraft.

Soon after the Wright brothers accomplished their historic flight they approached the U.S. Army and attempted to sell their new invention. With no previous experience to guide them, the Army was limited in their enthusiasm and bought only a few aircraft for use in the Signal Corps. A lack of appreciation for the value of airpower in combat, coupled with the existing practice of maintaining a very small standing military unless mobilization was necessitated by impending conflict, caused the Army to invest little in aircraft prior to World War I. When the U.S. entered the war in early 1917 there were less than half a dozen aircraft manufacturers in the country that had produced more than ten airplanes, and none of those had ever developed a successful combat aircraft.¹⁹ As the U.S. contemplated entering the war this lack of engineering and production capability prompted a mission to Europe led by Major Raynal C. Bolling with the objective of determining which European aircraft designs might be produced in America, as well as learning the required production techniques.²⁰ Bolling and his team submitted their report in the fall of 1917, and an ambitious aircraft production program was initiated. By the spring of 1918 the program was receiving general criticism over its inability to provide even one aircraft to support deployed troops, let alone the 5000 projected by that time.²¹ Design efforts were no more effective. Not one aircraft designed entirely in America arrived in Europe in time to be of value before the war ended.²²

Well before the Americans entered the war many had realized that they would have to rely on European aircraft if they participated. This was not only galling to the nation that had invented the airplane, but also underscored its vulnerability in future wars

¹⁸ For media examples see the Seattle Times, which calls the move “breaking new ground” (http://seattletimes.nwsources.com/html/business/technology/2004251273_webtankerwin29.html) and the USA Today, which says the move could allow foreign countries to “break into the world’s largest military market”. For blog examples, see <http://www.humanevents.com/article.php?id=27925> and <http://patdollard.com/2008/02/france-gets-aerial-refueling-tanker-contract/>.

¹⁹ Holley, I.B., Jr., *Ideas and Weapons*. 1953, New York: Yale University Press, 103.

²⁰ Nalty, B.C., ed. *Winged Shield, Winged Sword: 1907-1950, A History of the United States Air Force*. Vol. 1. 1997, Air Force History & Museums Program: Washington, DC, 48.

²¹ “Aircraft Board Takes up Charges”, New York Times, March 19, 1918.

²² Holley, 106.

if foreign help was not available.²³ Recognizing the need to begin at the basic research level if the nation was to develop a self sufficient aircraft industry, Congress passed legislation creating an Advisory Committee for Aeronautics, which became known as the NACA.²⁴

The armistice of 1918 brought about the usual demobilization, and the air service, which was relegated to a role subservient to the infantry, was affected disproportionately. Funding levels, however, remained higher than pre World War I levels. Another advantage was the wealth of experience and creative thought possessed by World War I veteran pilots. Despite the improved situation, as World War II approached America found itself in a situation similar to the prelude to World War I; flying aircraft that were inferior to those flown by the European countries. The difference this time was that, along with a determination to arm itself, the nation possessed the ability to make up ground with increased resource commitments. This was helped by the fact that European development and production efforts were hampered by the war.²⁵

With increasing aggression by Germany and her allies, U.S. sentiment was leaning steadily toward those fighting the Axis powers. As early as 1938 President Roosevelt began asking for funds to build up the Air Corps. By early 1940, months before the bombing of Pearl Harbor, and even before the Battle of Britain, Roosevelt was convinced that the U.S. would be required to provide aircraft for the Allies. He called for a force of 50,000 aircraft, knowing that many would be exported.²⁶ By the end of the year he would follow this up with his presentation of the Lend-Lease plan. With the stirring words, "We must be the great arsenal of democracy," he laid out how the US would supply the necessary arms to those fighting against dictators.²⁷ The mindset of the nation, both military men and civilians alike, began to shift from that of being self sufficient, to being a dominant provider of weapons to other nations as well. This was further inculcated by the role America's superior weapons played in the successful outcome of the war. The culminating feat, the surrender of Japan which was made possible by the pinnacle of new weapon technology; the atom bomb delivered by modern long-range strategic bombers, added an exclamation point to perceived American dominance in weapons development capability.

The level of commitment required to conduct global warfare at the intensity of World War II could not be maintained long after hostilities ceased. Nor were America's allies in a position to maintain large military forces while struggling to rebuild. Nevertheless, with the rise of the Soviet Union as a potential aggressor in Europe, for the first time it was not safe to demobilize as had been the practice. In response to these conflicting demands President Truman chose to demobilize personnel while maintaining strength through weapon technology.

America's European allies had very weak economies as they recovered from World War II and relied heavily on U.S. aid. This was especially true for military spending. Besides Great Britain, most allies chose to base their defense very heavily on

²³ Ibid, 103.

²⁴ Bilstein, R.E., *Orders of Magnitude: A History of the NACA and NASA, 1915-1990*. 1989, National Aeronautics and Space Administration.

²⁵ Nalty Vol. 1, 165-175.

²⁶ Nalty Vol. 1, 165-175.

²⁷ Roosevelt, Franklin D.. "The Great Arsenal of Democracy." 29 DEC 1940.

U.S. troops and weapons. This persisted into the 1960s when Secretary of Defense Robert McNamara began prodding NATO allies to contribute more to the effort.²⁸

As a result of the post World War II condition of America's allies, war plans throughout the remainder of the 1940s and into the 1950s relied heavily on America's monopoly of nuclear weapons and the ability of the Air Force to deliver them.²⁹ It is clear that America saw itself as continuing its role as the source of strength for its allies. As President Eisenhower explained in his 1954 State of the Union Address, "More closely than ever before, American freedom is interlocked with the freedom of other people. ... We shall, therefore, continue to advance the cause of freedom on foreign fronts."³⁰ This attitude was born out in the Korean War, which although was technically a coalition effort under the auspices of the UN, was predominantly a U.S. effort in terms of force levels and leadership. This was especially true of air forces.³¹ Thus the attitudes of its allies contributed to the mindset that America was the source of military weapons.

During the Cold War, not only did America see itself as the source of weapons, and especially air force weapons, for its allies, but it trusted only itself to employ those that were most advanced, namely nuclear weapons and their delivery platforms. Even after some of its NATO allies had developed nuclear weapons, war plans in Europe were based on a limited conventional capability that would act as a "trip wire" for nuclear forces, the bulk of which would be delivered using strategic platforms based in the U.S.³²

As US policy shifted away from massive retaliation and a reliance on nuclear weapons to flexible response and more of a reliance on conventional weapons, America did not see its role changing. Vietnam was an attempt to stabilize a geographical area where both the French and the South Vietnamese governments had been incapable of doing so. In the European theater plans went from a conventional force that would have to survive no more than 30 days, to one that could last at least 90 days before nuclear forces would be introduced.³³ Besides the strategic nuclear forces that continued to protect Europe, a large conventional force now stood ready to be sent to sustain the allies in time of need. The deployment of these conventional reinforcements was tested regularly in exercises such as REFORGER.³⁴ The Air Force Tactical Air Command (TAC) saw reinforcing Europe as a large part of its mission and derived great pride in their ability to do that.³⁵

With a greater emphasis on conventional forces, and with some NATO allies possessing nuclear weapons, there was a greater opportunity for other countries to assume a more prominent role in providing weapons for Europe's defense. Most of the

²⁸ Oral History Interview of Lt. Gen. Howard M. Fish, USAF (Ret.) by Capt. Mark C. Cleary, 3-5 February 1982. Typed transcript p. 196, K239.0512-1304 Iris No. 01052947, in USAF Collection, AFHRA.

²⁹ Ross, S.T., *American War Plans 1945-1950*. 1988, New York: Garland Publishing, Inc. 18.

³⁰ Eisenhower, Dwight D., State of the Union Address, 7 JAN 1954.

³¹ Nalty, B.C., ed. *Winged Shield, Winged Sword: 1950-1997, A History of the United States Air Force*. Vol. 2. 1997, Air Force History & Museums Program: Washington, DC, 4, 6.

³² Ross, 16.

³³ Oral History Interview of Gen. David A. Burchinal, USAF by Col. John B. Schmidt and Lt Col Jack Straser, 11 April 1975. Typed transcript p. 148, K239.0512-837 Iris No. 01011174, in USAF Collection, AFHRA.

³⁴ See "REFORGER." 27 APR 2005. GlobalSecurity.org, accessed 8 Sep 2008, <<http://www.globalsecurity.org/military/ops/reforger.htm>>.

³⁵ Oral History Interview of Gen. Lew Allen, Jr., USAF (Ret.) by Dr. James C. Hasdorff, 8-10 January 1986. Typed transcript p. 205, K239.0512-694 Iris No. 01105260, in USAF Collection, AFHRA.

help from allies came in the form of European nations buying weapons from the U.S., which were superior to those that could be developed by the much less advanced weapons industry in Europe.³⁶

During this period of conventional build up, intelligence estimates reported a vast superiority in numbers of Soviet forces over NATO forces. Conceding that NATO would never be able to match Soviet numbers, the decision was made to rely on technology to counter the numerical imbalance.³⁷ For NATO's air forces this meant that they would buy fewer aircraft that were significantly more capable than the opposing Soviet aircraft.

While the debate over quantity versus quality of forces goes back at least as far as aircraft have been flying in serious combat, for Americans quality has always been the preferred option. Noted historian, I. B. Holley, offers credible evidence that this was the case in World War I, concluding that, "quality paid better dividends than quantity".³⁸ That America gave much credit to technology, especially that related to the atomic bomb, for winning World War II has already been stated. As the war ended, General Henry H. "Hap" Arnold instituted the Air Force Scientific Advisory Board, and put in place a lasting scientific infrastructure to ensure America would maintain its technological advantage. He cited an inherent American distaste for casualties as a rationale for pursuing quality weapons.³⁹ This view continued without significant challenge until the opposition found a voice in the so-called "fighter mafia" beginning in the mid to late 1960s. This group included such people as Colonels John Boyd and Everest Riccioni, in the Air Force, and Pierre Sprey and Chuck Myers from the Office of the Secretary of Defense. They vociferously pushed for numerous simple fighters to counter the numerical superiority of the Warsaw Pact air forces.⁴⁰ While they had a significant influence on fighter development, they were ultimately unsuccessful at reversing the propensity to choose quality over quantity.⁴¹ The emphasis on high technology weapons that favored quality was instrumental in maintaining America's role as an exporter of weapons, and not an importer.

As the Vietnam Conflict was coming to a close President Nixon issued what came to be known as the Nixon Doctrine. In his words, "We will continue to provide elements of military strength and economic resources appropriate to our size and our interests." ... But the US "will participate, where our interests dictate, but as a weight -- not the weight -- in the scale."⁴² In his speech to the nation introducing his Vietnamization plan he explained that "...we shall furnish military and economic assistance when requested in

³⁶ Burchinal Interview, p. 215.

³⁷ Collins, J.M., *U.S. - Soviet Military Balance: Concepts and Capabilities, 1960-1980*. 1980, New York: McGraw-Hill, pp. 229-230, 490. Also, Interview with Gen Larry Welch, USAF (Ret.), Alexandria, VA, April 27, 2008; Allen Interview p. 186; and Myers interview.

³⁸ Holley, 176.

³⁹ Letter from General "Hap" Arnold to Dr. Theodore von Karman, dated 7 November 1944, reprinted in: Gorn, M.H., ed. *Prophecy Fulfilled: "Toward New Horizons" and Its Legacy*. 1994, Air Force History and Museums Program: Washington, DC. 86.

⁴⁰ Interview with Colonel Everest Riccioni, USAF (Ret.), Rancho Palos Verdes, CA, August 16, 2007; Interview with Harry Hillaker, Fort Worth, TX, September 21, 2007; Myers interview; Welch interview.

⁴¹ Allen interview, p. 139; Myers interview, Riccioni interview, Welch interview.

⁴² President Nixon's second annual Foreign Policy Report to Congress, February 1971, as quoted in Laird, M.R., *Toward a National Security Strategy of Realistic Deterrence: Fiscal Year 1972-1976 Defense Program and the 1972 Defense Budget, Report to the House Armed Services Committee*. 1971, Department of Defense: Washington, DC. p. 24.

accordance with our treaty commitments. But we shall look to the nation directly threatened to assume the primary responsibility of providing the manpower for its defense.”⁴³ Accordingly, Congress approved funding to develop “...simpler and less expensive weapons to assist our allies”.⁴⁴ The Nixon Doctrine is significant in this context because it spells out in a formal policy the paradigm that has been evolving since World War I; namely that the US should be the leader in weapons development and the source of weapons to our allies.

The end of the Cold War has seen a decreased demand for weapons in Europe, an increase in the development of weapons by other nations, and more options to choose from for weapons importers, but the paradigm continues to wield influence. The U.S. has maintained its status as the largest exporter of weapons, by a wide margin.⁴⁵ Furthermore, up until the tanker source selection announcement, examples of major weapons acquisitions from other countries by the US remained almost unheard of.

4.0. Understanding the Paradigm

While the nation’s actions and policies over the past century show the evolution of the paradigm described, the reasons for it must be understood in order to relate it to weapons choices, and therefore to military strategy.

4.1. Maintenance of a Technological Base

In 1945 Thomas K. Finletter was asked by President Truman to conduct a study on what the future of airpower should be for the nation. The study, called the “President’s Air Policy Commission,” and later known as the “Finletter Commission,” identified the need for a strong aerospace industry as part of our defense posture. He called the engineering and management teams of airframe and engine companies a “precious asset”, and said, “the power of the United States as a totality must have these companies”.⁴⁶ Former Secretary of the Air Force Robert Seamans recently stated, “I feel very very strongly that we need a capability within our own country to design and manufacture the key elements of our defensive system.”⁴⁷ The ability to develop and produce the necessary weapons is considered a prerequisite to possessing the ability to defend the vital interests of a nation. By maintaining the technological base required for weapons development and production the U.S. retains control of its capability to defend itself.

This very issue has surfaced in response to the Grumman/EADS tanker selection. As one analyst framed it, “What if France decides it does not support or condone a future American military operation somewhere in the world and prohibits French companies from supplying parts to the U.S. armed forces?”⁴⁸ The ability to protect its interests

⁴³ Nixon, Richard. "Vietnamization Speech." Washington, DC. 3 NOV 1969.

⁴⁴ Laird, 58.

⁴⁵ Grimmet, R.F., *Conventional Arms Transfers to Developing Nations, 1994-2001*, C.R.S., 2002, The Library of Congress. p. 89; and Grimmet, R.F., *Conventional Arms Transfers to Developing Nations, 1999-2006*, C.R.S., 2007, The Library of Congress. p. 98.

⁴⁶ Oral History Interview of Thomas K. Finletter by Colonel Marvin Stanley, February 1967. Typed transcript pp. 2, 4, 10-11, K239.0512-760 Iris No. 01000314, in USAF Collection, AFHRA.

⁴⁷ Interview with Dr. Robert C. Seamans, Beverly Farms, MA, June 10, 2008.

⁴⁸ Francona, Rick. "Buying French tankers a poor decision." 4 MAR 2008. msnbc.com. 8 Sep 2008 <<http://www.msnbc.msn.com/id/23467526/>>.

depends on having the weapons necessary to do so, which pushes the nation to procure American weapons.

4.2. The U.S. Is the Only Source for Adequate Weaponry

As noted above, the U.S. came out of World War II with an advantage in weapons development. Having sustained little physical and economic damage from the war, while at the same time having made great technological strides in support of the war effort, the U.S. emerged as the leader. As a result of this if a country, the U.S. included, wanted to procure the most advanced weaponry it had almost no choice other than American weapons.

Lieutenant General Howard Fish, who served much of his Air Force career working with NATO, including a tour as Assistant Vice Chief of Staff for Readiness and NATO Matters acknowledged a bias among Air Force leaders toward procuring American weapons, but added, "I don't believe we should have a 'buy America only' policy. ... [but it] would probably be pretty hard to buy a combat airplane from the Europeans because I really think we do that better".⁴⁹ Lieutenant General Kelly Burke, was deeply involved in acquisition as the Deputy Chief of Staff, Research, Development and Acquisition. He expressed his opinion that the European-built Tornado fighter was a copy of the F-111 with half the range and payload, but at twice the cost, and that given the technological lead the U.S. had, it didn't even make sense for the Europeans to try to develop a new fighter.⁵⁰ Lieutenant General Hans H. Driessnack, who spent much of his career in Systems Command, as well as serving as Air Force Comptroller and as Senior Air Force representative on the U.S. Delegation to the Military Staff Committee of the United Nations noted that the French had built a weapons export industry, but dismissed it as substandard. "They are very poor logistically," was one complaint.⁵¹ Whether these views are well-founded is not nearly as important as the fact that they were held by Air Force decision makers.

The attitude that assumes that if America wants a top quality weapon they must produce it themselves is still prevalent. Despite considerable advances in combat aircraft technology in the past few decades by foreign countries, the idea that they all are still substandard to American technology is very common. An informal survey of commentary on the internet provides some illustration of this.⁵²

Perhaps more relevant are statements by the former Chief of Staff of the Air Force, General John Jumper, after becoming the first pilot to fly both the F-22 and the Eurofighter. Though the tone of his report is a diplomatic attempt to praise both aircraft, the assessment that the F-22 is superior to the latest European fighter is not masked: "'They are different kinds of airplanes to start with,' the general said. 'It's like asking us to compare a NASCAR car with a Formula 1 car. They are both exciting in different

⁴⁹ Fish interview, p. 197.

⁵⁰ Oral History Interview of Lt. Gen. Kelly H. Burke, USAF (Ret.) by Hugh N. Ahmann, 22-23 April 1991. Typed transcript pp. 356-358, K239.0512-2015 Iris No. 01120229, in USAF Collection, AFHRA.

⁵¹ Oral History Interview of Lt. Gen. Hans H. Driessnack, USAF (Ret.) by Hugh N. Ahmann, 19-20 October 1987. Typed transcript p. 345, K239.0512-1769 Iris No. 01114688, in USAF Collection, AFHRA.

⁵² See for example comments submitted by readers in response to: Lowe, Malcolm V.. "Russia's Radical Sukhoi S-37 Fighter Plane Goes Up Against Our F-22." *Popular Mechanics* JAN 2001 9 Sep 2008 <http://www.popularmechanics.com/technology/military_law/1281276.html>.

ways, but they are designed for different levels of performance.”⁵³ After praising the Eurofighter, he went on to specify where it falls short of the F-22. “‘The F/A-22 performs in much the same way as the Eurofighter,’ General Jumper said. ‘But it has additional capabilities that allow it to perform the Air Force’s unique missions. The F/A-22 Raptor has stealth and supercruise,’ he said. ‘It has the ability to penetrate virtually undetected because of (those) capabilities. It is designed to be a penetrating airplane. It can maneuver with the best of them if it has to, but what you want to be able to do is get into contested airspace no matter where it is.’”⁵⁴

Without addressing the validity of the attitudes that are apparent, it is clear that the attitudes do exist. Their existence will undoubtedly have an effect on weapons procurement decisions and the resulting strategy.

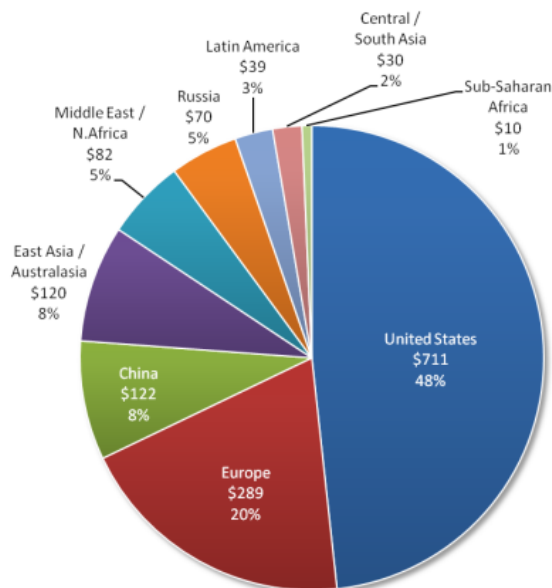
4.3. The U.S. Economy is Best Capable of Developing Weaponry

One reason the U.S. has excelled at weapons development is that the economy has supported the investment required. The size of the economy allows the country to limit the percentage of its gross national product spent on defense and still outspend the rest of the world, as the following graphic illustrates.⁵⁵

US Military Spending vs. The World, 2008

(in billions of US dollars and % of world total)

2008 Total Military Spending: \$1.473 Trillion



Source: Center for Arms Control and Non-Proliferation, February 20, 2008.

⁵³ Lopez, Todd C., Staff Sgt, USAF. "CSAF: Raptor, Eurofighter Complementary." *Air Force Print News* 22 MAR 2005 9 Sep 2008 <<http://www.af.mil/news/story.asp?id=123010102>>.

⁵⁴ Ibid.

⁵⁵ Chart taken from Shah, Anup. "World Military Spending." 1 MAR 2008. *Global Issues*. 9 Sep 2008 <<http://www.globalissues.org/article/75/world-military-spending>>.. See also "Worldwide Military Expenditures." 21 Sep 2007. *GlobalSecurity.org*, accessed 8 Sep 2008, <<http://www.globalsecurity.org/military/world/spending.htm>>

This larger budget has yielded large and advanced research and development, test, and production facilities which were out of reach for countries with smaller economies. General Driessnack explained that often there was a “mystique” surrounding U.S. weaponry, and that representatives of other countries had the attitude that if the U.S. Air Force bought something that came out of its procurement system, it had to be the best in the world. They also knew the system they bought would have sufficient logistics support for the life of the system.⁵⁶

In addition to the availability of money, a country must have the will to spend that money to build up its weapons development system. For years America’s NATO allies were content to rely on U.S. protection, and spent less than established NATO defense spending goals.⁵⁷ Lieutenant General Martin Colladay, who held the position of Deputy Chairman, Military Committee, NATO, described the European governments as “fragile” in this respect, and explained that it would be hard to stay in power if they spent enough on defense to meet NATO goals.⁵⁸ This was one of the reasons why NATO was consistently led by U.S. commanders (a situation fully acceptable to the European members) and always would be in his estimation.⁵⁹

The ability and willingness to fund the development of advanced weapons was limited for even the most affluent allies of the U.S. This fueled the paradigm of the U.S. as a supplier, versus an importer, of weapons.

4.4. Providing Affordable Advanced Weapons to Allies Supports National Policy

Given the shortfalls in funding goals of NATO allies during the conventional build-up during the 1970s and 1980s, the production of affordable advanced aircraft that could be made available to NATO countries was seen as a way to assure the defense of Europe against the Soviet Union.⁶⁰ This was accomplished with the F-104, which was later replaced by the F-16.⁶¹ While the F-104 provided mainly an air-to-air capability, the A-7 was sold to some NATO allies to bolster the air-to-ground capability. Where the sale of these aircraft did not support U.S. policies the weapons were not sold. For example, Pakistan and some South American countries asked to buy the A-7. Both were turned down because the U.S. felt the sale of those aircraft would have been destabilizing in those regions.⁶² When Northrop offered the F-20 (follow-on to the F-5), Taiwan and Peru wanted it, but the U.S. would not allow the sales because it would impair relations between the U.S. and other countries in the region.⁶³

⁵⁶ Driessnack Interview, pp. 272-273, 276.

⁵⁷ Oral History Interview of Lt. Gen. Martin G. Colladay, USAF (Ret.) by Hugh N. Ahmann, 18-19 October 1983. Typed transcript pp. 175-176, K239.0512-1546 Iris No. 01105090, in USAF Collection AFHRA; and Burchinal Interview, pp. 147-148.

⁵⁸ Ibid.

⁵⁹ Ibid, pp. 177-178.

⁶⁰ Oral History Interview of Lt. Gen. John J. Burns, USAF (Ret.) by Hugh N. Ahmann, 5-8 June 1984 and January 1986. Typed transcript pp. 305, 308, K239.0512-1587 Iris No. 01085466, in USAF Collection, AFHRA.

⁶¹ Burns Interview, p. 305

⁶² Oral History Interview of Gen. Gabriel P. Disosway, USAF (Ret.) by Lt. Col. John N. Dick, Jr., 4-6 October 1977. Typed transcript pp. 277-278, K239.0512-974 Iris No. 01052916, in USAF Collection, AFHRA.

⁶³ Burke Interview, pp. 334-338. Peru decided to buy Russian aircraft instead.

The F-5 Freedom Fighter program, which provided support for the Nixon Doctrine, provides another example. As Nixon stated, the U.S. planned to rely on allies, many of them less developed, to carry out successful combat operations in support of Democracy, partly on our behalf. To do this they would need to have weapons that were affordable. That meant that they would need to be unsophisticated enough to be able to keep a sufficient number of pilots trained in the aircraft, while at the same time providing adequate air combat capability. The F-5 was offered as the best, or at least most affordable, alternative available to meet these criteria.⁶⁴

Providing otherwise unobtainable advanced weapons can also be used as a “carrot” to influence countries to support policy. According to Lieutenant General Colladay, who besides his work with NATO also filled high staff positions in Korea during the Vietnam War, asserted that, “There are a very, very, very, few allies that will go out of their sphere to do something for you that we are not going to have to pay for.” To illustrate this, he points out that in return for Korea’s support for the Vietnam war, they were not only reimbursed for anything used by the U.S., but they also received modernized military equipment. The U.S. also committed more forces in Korea as a deterrent against North Korea.⁶⁵ Another example of this is the U.S. agreement to provide the UK with the AGM-48 Skybolt air-launched ballistic (nuclear) missile in return for opening up the Holy Loch facilities on Scotland’s West coast to American Polaris submarines in 1960.⁶⁶

4.5. Standardization

A compelling argument for having allies buy U.S. weapons is that great benefits can be reaped by having all allied forces use the same type of weapons. Standardization simplifies logistics and training, and facilitates planning of operations.⁶⁷ In conjunction with the arguments that American systems are superior and that its industry is more capable, this argument has been used to urge allies to buy those systems.⁶⁸

At times the U.S. has been criticized for using standardization as an excuse to boost its arms industry. For example, in the mid 1970s standardization was being pushed by the U.S. The proposal put forth was comprised of the following four systems around which NATO should standardize its air defense missiles: 1) Replace Redeye man portable missiles with the General Dynamics Stinger, 2) Adoption of the Raytheon Improved Hawk as the medium altitude surface-to-air missile, 3) Study the feasibility of acquiring the U.S. Army/Raytheon SAM-D air defense batteries for nine NATO countries, and 4) adopt the Franco-German Roland (produced in America) for the U.S. Army. Obviously many in Europe saw this proposal as a “buy American” campaign. Despite this, there was still considerable effort required by the Department of Defense to persuade the U.S. military to accept the Roland.⁶⁹

⁶⁴ Burns Interview, pp. 293, 296-297; and Disosway Interview, p. 278.

⁶⁵ Colladay Interview, pp. 125-126.

⁶⁶ Dumbrell, J., *A Special Relationship: Anglo-American Relations in the Cold War and After*. 2001, New York: St. Martin's Press, 173.

⁶⁷ Rogers, K.C. and C.R. Janson, *Origin of the F-16 Multinational Program: 1970-1977*, A. Force, Editor. 1983, Air Force Systems Command, p.85. Document declassified at author’s request on 1 Jul 2008.

⁶⁸ Fish Interview, p. 198.

⁶⁹ "NATO Missile Standardization Pushed." *Aviation Week & Space Technology* 3 June 2008: 61-71.

This combination of arguments; standardization coupled with superior U.S. weapons development and production capabilities, has been so successful that it has backfired at times, and actually hurt standardization. One example of this was the NATO effort to standardize their air-to-air fighters in the early 1960s. The American F-104 dominated the competing European offerings from Great Britain and France so overwhelmingly that they had no chance of comparing favorably. The resulting loss of prestige of the companies and the governments of those countries, both internally and internationally, prompted the British and the French to bow out of the program.⁷⁰

4.6. Being an Exporter of Weapons Helps the Economy

With global defense expenditures topping a trillion dollars annually, almost half of which is spent by foreign governments, there is a large economic incentive to excel in the defense industry.⁷¹ Also, with a consistently high U.S. trade deficit there is even more incentive to capitalize on defense export opportunities, for which the U.S. is the clear world leader.⁷² These economic incentives have contributed to the paradigm of the U.S. as an exporter versus an importer of weapon systems. They have been cited as reasons to sell U.S. weapons to other nations.⁷³ Much of the debate over the previously cited tanker contract centers around the loss of American jobs and the damage to the U.S. economy that would result by helping Airbus gain an advantage over Boeing in the commercial market.⁷⁴ As potentially the largest defense contract in history, the sheer size has guaranteed that it will be treated not only as a security issue, but also as an economic issue.

5.0. Relating Paradigms to Strategy

Understanding existing paradigms that affect decision makers can yield insights into how they will go about procuring weapons, and what types of weapons they will buy. The paradigm that the U.S. employs American-made weapons will, in turn, influence the strategy that those weapons support. Following are some strategy implications of the American-made procurement paradigm.

5.1. What America Buys Dictates How America Fights

While success of a weapon system can be defined differently to different people, by almost any standard the F-16 can be regarded as a highly successful combat aircraft.

⁷⁰ Rogers and Janson, p. 90.

⁷¹ For fiscal year 2008 the President requested \$481.4 billion for the nation's defense budget. ("FISCAL 2008 DEPARTMENT OF DEFENSE BUDGET RELEASED", DoD Press Release No. 129-07, 5 Feb 2007, available at: <http://www.defenselink.mil/comptroller/defbudget/fy2008/index.html> accessed on 9 Sep 2008) Percentage increase was calculated from data for the past 10 years from the same web page.; also GlobalSecurity.org, accessed 8 Sep 2008.

⁷² For trade deficit numbers see "Foreign Trade Statistics." 12 Aug 2008. U.S. Census Bureau. 10 Sep 2008 <<http://www.census.gov/indicator/www/ustrade.html>>. ; for defense export numbers see Grimmet, 2007, p. 98.

⁷³ For some examples see Gentry, J.R., *Evolution of the F-16 Multinational Fighter*. 1976, Industrial College of the Armed Forces: Washington, DC, p. 3; Burke Interview, p. 360; and Driessnack Interview, pp. 272, 346.

⁷⁴ See for example Rosenberg, Eric. "Gates warns on Tanker Contract - Defense Chief Tells Congress: It's Not about U.S. Jobs," [Seattlepi.com](http://seattlepi.com) 20 May 2008. 10 Sep 2008 <http://seattlepi.nwsource.com/business/363892_tanker21.html>

A look at its origins, however, reveals that its potential combat capability was only part of the criteria for its selection. It was also chosen to fulfill the need to provide American-made aircraft to U.S. allies. The resulting compromise has affected the way it has been employed.

The F-16 grew out of the lightweight fighter prototype program conducted in the early 1970s.⁷⁵ The previously mentioned “fighter mafia” was at that time advocating a small day/VFR fighter that could be produced in large numbers. The official Air Force position during this time was that its fighter needs would be fulfilled by the F-15, which was just beginning production, and there was a concern that the development of another fighter would jeopardize the number of F-15s the Air Force would be allowed to produce.⁷⁶ Despite the reluctance of the Air Force, on 29 July 1974 Secretary of Defense James Schlesinger issued the Program Decision Memorandum verifying an agreement he had made with the Air Force that the F-16 would be produced and enter the Air Force inventory, and in return for Air Force acceptance of this decision its force structure would be increased by four additional wings.⁷⁷ The decision of the Secretary of Defense to promote the procurement of the lightweight fighter (which later became the F-16) so strongly that he was willing to grant the Air Force increased force structure can be traced to his desire to sell it to foreign nations.

Lieutenant General John Burns, who served at the Pentagon as Director of Operational Requirements and Development Plans during this period states: “The only reason that the Air Force went into the lightweight fighter was because of the extreme pressure put on the Air Force by OSD to provide an affordable replacement to the F-104 ... for the overseas air forces. People can deny that if they want to, but that's the truth. The foreign countries had made it clear to us after the -104 experience and the F-5 that they were never more going to buy an airplane that wasn't inventoried by the United States Air Force.”⁷⁸ He goes on to state that the initial U.S. buy of 650 F-16s (although still in the form of the unspecified lightweight fighter) was determined by the need to produce enough to make the price more competitive than the French Mirage.⁷⁹ A GAO study offers the same opinion, stating, “The DoD decision to enter a full-scale development program and to produce and deploy the ACF [Air Combat Fighter, which later became the F-16] appears to be based more on the foreign sales potential of the ACF than on studies or analyses indicating an Air Force need for the ACF.”⁸⁰ Other documentation available serves to add credibility that this assertion is true, at least in part.⁸¹ Even if General Burns’ assertion that foreign sales is the only reason the U.S. Air Force procured the F-16 is overstated, it is apparent that it played a significant role.

⁷⁵ Rogers and Janson, pp. 6-9

⁷⁶ Colonel Raymond H. Ottoman, Chief, Aircraft Division, DCS/Development Plans, Memorandum for Record, Subject: “Lightweight Fighter (LWF) Development Program Briefings, 21-23 Jan 1974”, 25 Jan 1974.

⁷⁷ “The Office of the Secretary of Defense”, Schlesinger, James R. in Hays, P.L., B.J. Vallance, and A.R. Van Tassel, eds. *American Defense Policy*. Seventh ed. 1997, The Johns Hopkins University Press: Baltimore, MD, 107; and Stevenson, J.P., *The Pentagon Paradox: The Development of the F-18 Hornet*. 1993, Annapolis, MD: Naval Institute Press. 176.

⁷⁸ Burns Interview, p. 305.

⁷⁹ *Ibid.*, p. 308.

⁸⁰ G.A.O., *Lightweight Fighter Prototype Program and the Air Combat Fighter Program*. 1975, GAO: Washington, D.C. p. 35.

⁸¹ Rogers and Janson, pp. 81-85.

The decision to procure a given weapon system affects the strategy of the U.S. military in various ways. A given system will provide opportunities for improving capability as well as imposing limitations, and the F-16 is no exception. Military operations will necessarily be planned around the capabilities and limitations of the equipment available for use.

The idea of a high-low mix had been discussed years before the lightweight fighter program began. The concept entails procuring an efficient mix of some expensive extremely high technology fighters, mixed with a larger number of low cost fighters of lower technology to fill out the force. The expected advantages of the strategy are greater numbers of fighters for less money, less demanding training and maintenance requirements associated with lower technology, and an affordable export aircraft that won't transfer too much technology to other countries. The possible disadvantages are a loss of overall capability by trading away more capable aircraft for greater numbers, more involved logistics by maintaining two types of aircraft, and a larger training and maintenance infrastructure required to deal with the increased numbers of aircraft.

While the lightweight fighter program was under consideration supporters on each side of the debate worked to build support for their respective views. The process described by Latour was undertaken by both sides to convince enough decision makers of the validity of their position. Combat experience from World War II, in which allied forces finally overwhelmed the enemy, bolstered the arguments of those who pushed for a greater number of lightweight fighters,⁸² while others tried to show how superior German technology at the end of the war would have been decisive if the new jet fighters had been produced in reasonable numbers.⁸³ Analysis was used by both sides in attempts to prove the truth of their positions, only to have assumptions and methods questioned.⁸⁴ Leaders used their influence and authority to attempt to line up allies for one side or the other.⁸⁵ Despite the arguments employed, it has been shown that one compelling argument was that the lightweight fighter was suitable to equip the U.S. Air Force and its allies while still giving them sufficient capability. Among those who held this view were the Secretary of Defense and those he could convince through reasoning or bargaining.

Once the decision to develop and produce a lightweight fighter was made and carried out, the U.S. Air Force was committed to a high-low mix strategy, with all of its advantages and disadvantages. The debate goes on, as enthusiasts of the F-16 tout its combat successes, long production run, ubiquity, bombing accuracy, and kill ratio.⁸⁶ Detractors, on the other hand, point out that the "low" aircraft in the mix has limited range, needs more support aircraft due to less onboard technology, and has less payload capability due to smaller size. Regardless of which position is more convincing, each of these factors, positive or negative, now contributes to current U.S. military strategy. They became factors in determining the strategy as a result of the decision to procure the

⁸² Oral History Interview of Lt. Gen. Arthur C. Agan, USAF (Ret.) by Lt. Col. Vaughn H. Gallacher, 19-22 April 1976. Typed transcript p. 178, K239.0512-900 Iris No. 01033136, in USAF Collection, AFHRA; also Myers Interview; and Riccioni Interview.

⁸³ Myers Interview.

⁸⁴ Welch Interview; Riccioni Interview, Stevenson, pp. 2-4.

⁸⁵ Myers Interview; Riccioni Interview; Welch Interview; Hays, p. 107.

⁸⁶ See for example "F-16 Viper Pilots Association." 13 Jan 2003. 10 Sep 2008 <<http://www.f16viper.org/>>.; also F-16 Fighting Falcon Fact Sheet. Retrieved October 11, 2007, from Air Force Link: Official Site of the U. S. Air Force Web site: <<http://www.af.mil/factsheets/factsheet.asp?fsID=103>>

lightweight fighter, which was influenced by the American-made weapons procurement paradigm.

5.2. America's Procurement Paradigm Is Related to Its Employment Paradigm

The American-made weapons procurement paradigm is based, in part, on the need to maintain the weapons technology base in order to assure that the nation will have the appropriate weapons available when it needs them. As previously illustrated, the reliance upon another nation to equip U.S. forces could lead to the supplier exerting control over the employment of those forces, whether intentionally or because of supply problems. Either situation would leave the U.S. vulnerable, and is unacceptable. Because the U.S. depends on its weapons to protect its vital interests it will accept only the most capable weapons for procurement. The paradigm insists that in order to assure procurement of the best weapons, those weapons need to be American-made. The ability to defend vital interests, however, relies not just on the ability to procure the necessary weapons, but also on the ability to use them when those interests are threatened. Thus the procurement paradigm fuels the disposition to act unilaterally when deemed necessary.

This relationship works in the other direction as well. The disposition to employ forces unilaterally helps determine the requirements for new weapons. Requirements for strategic bombers, long range transports, and tanker aircraft reflect the necessity to engage in combat in all possible theaters with minimal dependence on foreign basing or overflight. The capability and willingness to act without the support or consent of some allies has been demonstrated numerous times.⁸⁷ This has served to validate and further the practice, which reinforces the paradigm that yields the weapons that make it possible.⁸⁸

5.3. America's Procurement Paradigm Affects Its Relationship with Allies

The efforts of America to sell weapons to its allies has not always been received with enthusiasm by the buying nations. The examples of the F-104 overshadowing the French and British offerings, the F-16 being designed to outshine the Mirage, and the missile standardization effort have been cited. Some people go so far as to hold the position that the main purpose of NATO is to sell arms to Europe in order to boost the

⁸⁷ For example, Operation Nickel Grass, the resupply of Israel during the 1973 Yom Kippur War; Operation El Dorado Canyon, when U.S. F-111s bombed Libya for its part in terrorist plots; and Operation Iraqi Freedom. In Nickel Grass Portugal was the only European country that chose to lend any support with their permission to allow aircraft to stop enroute at Lajes Field, Azores. See Krisinger, Chris J. "Operation Nickel Grass: Airlift in Support of National Policy." *Airpower Journal* Spring 1989 10 Sep 2008 <<http://www.airpower.maxwell.af.mil/airchronicles/apj/apj89/spr89/krisinger.html>>. In El Dorado Canyon the French refused overflight to U.S. aircraft requiring them to go all the way around and which required a massive tanker force. See "Operation El Dorado Canyon." 27 APR 2005. GlobalSecurity.org. 10 Sep 2008 <http://www.globalsecurity.org/military/ops/el_dorado_canyon.htm> ; Operation Iraqi Freedom was openly opposed by such key allies as France.

⁸⁸ Boyne, Walter J. "Nickel Grass." *Air Force Magazine* 81.12Dec 1998 8 Sep 2008 <<http://www.afa.org/magazine/dec1998/1298nickel.asp>>. Boyne claims that Nickel Grass served to justify the previously troubled and expensive C-5. Also Schonauer, Scott. "General: Air Force Needs More Cargo, Tankers," *Stars and Stripes* 16 Apr 2005. 10 Sep 2008 <<http://www.stripes.com/article.asp?section=104&article=27649&archive=true>>. Tankers and large transports have allowed the Air Force to fight the global war on terror, which has highlighted the requirement to replace and update the capabilities.

American defense industry, while keeping European companies from breaking into the market.⁸⁹ While that may be an extreme view, the fact that American dominance in the industry, and its unwillingness to seriously consider procuring foreign systems while at the same time expecting other countries to buy its products, has caused some animosity.⁹⁰

Like most other industries, the defense industry is becoming more globalized in nature. One result of this is that foreign countries are now developing advanced weapon systems that compare more favorably with American systems. While this has challenged some components of the American-made paradigm such as the idea that in order to get the most advanced systems they must be American-made, it reinforces other components such as the need to buy American in order to preserve the technological base in the U.S. aerospace industry. As allies see America make conscious choices to avoid buying foreign made weapons, even when the weapons are of high quality, it could cause mistrust and a divergence of interests. This could lead to more instances where America will have trouble convincing once reliable allies that their interests and American interests coincide sufficiently for the allies to lend support.

6.0. The Future of the American-Made Weapons Procurement Paradigm

Thomas Kuhn postulated that when the existing data no longer supports the existing paradigm, either the paradigm needs to change to incorporate new data, or be abandoned in favor of a new paradigm. It is evident that new data exists. The end of the Cold War and the Soviet Union as a common enemy for America and its allies, the globalization and increased competitiveness of the defense industry, and the emergence of economies such as the EU and China that can begin to rival that of America are data points that must be incorporated into the paradigm if it is to persist.

While this study has concentrated on the history leading up to the present time, decisions made in the present will determine the further validity of the paradigm. Two cases can illustrate the questions that arise.

6.1. The F-35

The F-35 is the first case. The Joint Strike Fighter program office bills the F-35 as “the world’s foremost stealthy, supersonic, survivable, lethal, supportable and affordable multi-role fighter.”⁹¹ The current program had its origins in several programs beginning in the 1980s. In late 2001 it entered the System Development and Demonstration (SDD) phase.⁹² The aircraft has made progress in jointness, having been accepted by the U.S. Navy and Marine Corps, as well as on an international scale, with the UK Ministry of Defence participating as a full collaborative partner in the program. Subsequently the program was joined by cooperative partners: Denmark, Norway, The Netherlands, Canada and Italy, and foreign military participants: Singapore, Turkey, and Israel, with others likely to join.⁹³

⁸⁹ See for example Shah, Anup. "The Need for NATO." 19 Mar 2001. Global Issues. 10 Sep 2008 <<http://www.globalissues.org/article/125/the-need-for-nato>>.

⁹⁰ See for example "NATO Slams U.S. Arms Sales." 20 Nov 1997. Intelligence Online. 9 Sep 2008 <http://www.intelligenceonline.com/Identification/p_identification.asp?rub=login =ANG&service=ART &context=ARC&doc_i_id=67679>.

⁹¹ "The F-35 Lightning II." Joint Strike Fighter Program Office. 9 Sep 2008 <<http://www.jsf.mil/>>.

⁹² Ibid.

⁹³ Ibid.

Will the F-35 be another F-16 program, which is basically an American airplane with some foreign involvement in its production? Or will this increased level of foreign participation, albeit limited, be the first steps of a new paradigm of true international development? If the paradigm were to change, would the U.S. still be able to meet its perceived needs of adequate control over its defense as well as receive the economic benefits for its aerospace industry? Given that the beginnings of the F-35 occurred over twenty years ago, at which time the American-made paradigm was still relatively unchallenged, these answers may not be available until the next fighter is developed.

6.2. The new U.S. Air Force Tanker

The second case is the U.S. Air Force's new tanker which has been discussed. This is a different case than the F-35, which was conceived to be an export aircraft. While some foreign tanker sales were likely, relatively few other countries maintain an aerial refueling capability, and the U.S. tanker force is many times larger than those of all other countries combined. For this reason the tanker program approximates a strictly domestic program. A second difference is that for the first time a foreign company, EADS, attempted to submit a serious proposal for a domestic U.S. requirement for such a major program. This went way beyond collaborating or participating, as in other programs with international partners.

Of course some were surprised EADS even entered the competition. Most thought the weak attempt to paint the foreign proposal as American by enlisting Northrop Grumman as a partner, or even the concession that the final assembly of the tanker, as well as commercial versions of the A330, would be accomplished in America, were not enough to give the proposal serious consideration. The American-made weapons procurement paradigm was evident. "Surprise" and even "shock" appeared frequently in news stories announcing that the EADS proposal won.⁹⁴ Boeing, whose submission was a tanker version of the 767⁹⁵ filed a protest soon after and the announcement, and the GAO ruled that parts of the competition had been unfair. Since then the Department of Defense has taken over the program from the Air Force and will release a new request for proposals for a completely new competition after the new presidential administration is in place next January.⁹⁶ The program will be set back by at least a year.⁹⁷

Of course it remains a question whether EADS can win the next competition. Whether they win or not it will raise questions for the future of weapons procurement, and therefore military strategy. If Boeing were to get the contract would that mean that the American-made paradigm is still firmly in place, and if so, should it be? Would the

⁹⁴ See for example Powell. Stewart M. "At Boeing, Shock - Then Anger," Seattlepi.com 29 Feb 2008. 10 Sep 2008 <http://seattlepi.nwsource.com/business/353250_tanker01.html>; and Litterick. David. "Pentagon Awards Air Tanker Contract to EADS," Telegraph.co.uk 4 MAR 2008. 10 Sep 2008 <<http://www.telegraph.co.uk/money/main.jhtml?xml=/money/2008/03/03/cneads103.xml>>.

⁹⁵ Ironically one European country, Italy, has already bought some of the American Boeing tankers in anticipation of the logistics support that would be available had the Americans bought them. Even the Italians thought the paradigm was alive and well. See "Boeing Commercial 767 Ready for Modification into Fourth Italian KC-767 Tanker." 1 MAR 2007. GlobalSecurity.org. 10 Sep 2008 <<http://www.globalsecurity.org/military/library/news/2007/03/mil-070301-boeing01.htm>>.

⁹⁶ Garamone. Jim. "Secretary Gates Cancels Air-Refueling Solicitation," Air Forces Press Service 10 Sep 2008. U.S. Air Force. 10 Sep 2008 <<http://www.af.mil/news/story.asp?id=123114543>>.

⁹⁷ Ibid.

reversal irreparably damage an already strained relationship with France? And would other allies feel alienated? If EADS were to win again, would it signal the beginning of a new paradigm with foreign competition in the U.S. weapons market? Or would there be a backlash that would try to assure something similar didn't happen again, thus reinforcing the American-made paradigm? If the U.S. were to open its market to foreign suppliers would it lose its capability and/or willingness to employ forces unilaterally?

6.3. Conclusion

Answering the above questions is beyond the scope of this paper, and in fact is not possible until future events unfold. The purpose of asking them is to highlight the existence of an accepted thought pattern, or paradigm, that influences the way decision makers choose weapons, and that those weapons, in turn, affect strategy. Understanding the origins of the paradigm with which decision makers are working, as well as the reasons for the paradigm, can help determine if it is valid, or if an adjustment or a replacement is in order.