Spacelift: Search for a Nation Vision

MCWAR 1997

Subject Area National Security

SPACELIFT: SEARCH FOR A NATIONAL VISION

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30 April 1997

Submitted in Partial Fulfillment
of the Requirements for the
Marine Corps War College
Marine Corps University
Marine Corps Combat Development Command
Quantico, VA 22134-5067

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
1997		**00-00-1997 to 00-00-1997**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Spacelift: Search for a Nation Vision	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Marine Corps War College,Marine Corps University,Marine Corps Combat Development Command,Quantico,VA,22134-5067**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**42**	

ABSTRACT

The growing importance of spacepower to the economic, political and military health of America has emerged in the closing years of this century. As space becomes more dominant as the nation's lifeline to the 21st century, modern warfare demands that our armed forces fight as a joint team in uncertain challenging environments. Future warfighting as expressed in Joint Vision 2010 lays out the concepts of dominant maneuver, precision engagement, full dimensional protection, and focused logistics. The proper exploitation of space is vital to these concepts. Recommendations include:

1. Lead agency concept should be maintained to focus limited resources.
2. Consider building a heavy lift vehicle versus status-quo medium lift one.
3. Exploit Russian launch technology to rebuild U.S. spacelift capabilities.
4. Consider Russian technical labor to build next U.S. spacelift vehicle.
5. Combine all space lift acquisitions under a separate appropriation.
6. Create separate joint budget authority for spacelift, like SOCOM.
7. DoD should budget functions that clearly cut across the traditional Army, Air Force, and Navy roles and missions and are of critical benefit to DoD's joint warfighting future. Under this approach any service could nominate joint requirements or priorities that DoD would fund off the top of the budget before individual services get their cut.

The nation must have a long range vision of how to exploit space, leadership capable of executing that vision, and proper funding to ensure it is successful. Nothing less than space dominance capable of ensuring our survival in the next century is at risk. The United States must develop a coherent long term space launch policy that ensures economical, reliable, and assured access to space. It must also ensure that it remains the world's leader in space. In order to dominate space, the U.S. should build a mix of manned and unmanned space launch vehicles capable of guaranteeing U.S. present and future roles in space.

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CHAPTER 1
SPACE: THE FOURTH DIMENSION

U.S. national security interest requires a long range vision designed to provide assured, reliable, and affordable access to space. A careful examination of historical national security interests reveals a consistent emphasis on ensuring our survival as a nation, securing the lives and property of our citizens, and protecting our vital national interests. In the 19th century, securing the sea lanes provided the single most important avenue for advancing those interests.[1] The advent of airpower added a second vital approach in the early 20th century. The growing importance of spacepower to the economic, political and military health of a nation has added a third critical avenue in the closing years of this century. As space becomes more vital to the nation's 21st century lifeline, several factors require attention. The nation must have a long range vision of how to exploit space, leadership capable of executing that vision, and proper funding to ensure it is successful. The stakes are high. Nothing less than space dominance can guarantee our survival the next century.

> The United States is becoming increasingly dependent on space assets for the conduct of peacetime and wartime military operations. The Gulf War was the first "space-age" war in which space based assets played critical roles in communications, navigation, weather prediction, missile launch detection, and intelligence gathering. Future military actions will all depend heavily on space based assets.[2]

Spacelift is not only crucial to access space, but remains the only method for deploying on orbit space assets today. The U.S. can't afford to become a second-rate spacepower because of a failure to provide adequate lift capability.

Modern warfare demands that our armed forces fight as a joint team in uncertain environments with space control serving as the key enabler for success. Future warfighting, according to Joint Vision 2010, "embodies the improved intelligence and command and control... to develop the four operational concepts: dominant maneuver, precision engagement, full dimensional protection, and focused logistics."[3] The proper exploitation of space is vital to the way we choose to implement all four concepts. Denying enemy eyes

and ears from space will continue to allow surprise in Army dominant maneuvers like the left hook in Operation Desert Storm. Friendly eyes, ears and navigation precision will allow precision engagements from air and space platforms like the airborne laser lab. Space control is a key requirement for force protection. It ensures that future enemy threats air, sea, land or space, such as theater ballistic missiles, with or without weapons of mass destruction, are detected and negated earlier and farther out. Bar-coded logistics read from space will ensure lighter and cheaper footprints abroad and faster re-supply to future forces. Space, and reliable access to it, is a vital enabler for successful future peacetime and wartime operations across all services and all levels of conflict.

The new, emerging form of warfare is dependent on vast amounts of information. It will replace old concepts with warfare fought in compressed time, using precision and seeking to exploit parallel attack to achieve specific effects. "By 2010...the most intense joint operations...[i]nstead of relying on massed forces and sequential operations,...will achieve massed effects"[4] with information superiority, a more lethal battle space, and new operational concepts: dominant maneuvering, precision targeting, full dimensional protection, and focused logistics. The definition of mass is no longer large numbers. Mass is now precision delivery in parallel war. Recognizing the vital nature of space to these operations on September 19, 1996, the president released his national space policy: "This policy, among many other things, directs the nation to maintain its pre-eminent position as the world's No. 1 space power in order to assure support for terrestrial military/civil operations. Like airpower, control and access to the benefits of space, spacepower, must be maintained and protected."[5] This type of strategic vision places the proper emphasis on space dominance but requires significant additional thought for successful application. Six years of thought after the Gulf War haven't brought consensus on this problem even though all parties recognize the need for controlling space. Given the immediate domestic priorities, quadrennial defense review, and shrinking defense budget, services are too focused on

traditional organizational survival and behavior to properly recognize or properly prioritize the importance of space.

Space control or space dominance provides a series of vital benefits for the joint force commander. These developing concepts are very similar to the ideas of sea control or air dominance. However, unlike these older concepts, space control allows dominance across all mediums of communication and transportation. Space control promises to allow domination of air, land, sea, and information. Even now it prevents adversaries from interfering with operations of air, space or surface forces, and assures freedom of action and movement. Space is the ultimate high ground:

> Space... answers the age-old wish of military commanders to be able to see the other side of the hill. Variously defined in the past as both a place and a mission, space is also a laboratory of the unknown; a potential area for commercial exploitation; a medium in which surveillance, communication, navigation, and transit are now routine; and an arena of increasing cooperation, competition, and potential conflict. Spacecast 2020[6]

Furthermore, air and space control is a critical enabler for the Joint Force because it frees U.S. forces from fear of attack and leaves them free to attack. Air and space superiority gives joint forces the ability to dominate enemy operations in all dimensions - land, sea, air and space.[7] As a result, air and space superiority is a strategic imperative for protecting American lives throughout a crisis or conflict.[8] Dominant maneuver, full-dimensional protection, surface maneuver, strategic attack, and interdiction are vital to battlefield success and are not possible without air and space superiority. This means everything on the battlefield is at risk without air and space control.[9] If air and space dominance is achieved and joint forces can operate with impunity throughout the adversary's battlespace, the joint force commander will quickly prevail, efficiently and decisively.[10] The chairman's vision simply states: "Persuasive in Peace, Decisive in War, Preeminent in any form of conflict."[11] General Fogleman, CSAF, predicts "American forces in future years will be facing an increased array of threats from space" and added that the U.S. must "not allow

an adversary to control space, to have the upper hand in space."[12] If operations in and control of space are vital to enhancing future United States national security, then assured, reliable and affordable access to space is the critical requirement and enabler which will require a cohesive long-term vision, leadership and funding for implementation. In future war, the failure to maintain space control will mean that air superiority, ground operations, and sea operations will be impossible.

ACCESSING SPACE

Before a coherent long term vision for access to space can emerge, it is important to understand the legacy of spacelift in terms of infrastructure, people, and economic competitiveness. Today, the U.S. primarily relies on an army of military and civilian personnel to operate a series of continuously modified Atlas, Delta, and Titan boosters. These were originally developed in the 1950s and 1960s as Intermediate Range Ballistic Missiles (IRBMs) and Inter-Continental Ballistic Missiles (ICBMs), to access space for military missions. The Space Transportation System (STS), or shuttle, flies civil scientific missions, but also has the capability to fly military payloads if necessary. Meanwhile, commercial launches, mostly geostationary communications satellites, are contracted and flown aboard U.S. non-shuttle or foreign launch vehicles depending upon cost, risk of launch failure, and scheduling constraints. This situation is illustrative of the chaotic nature of just the launch system situation. Lacking a clear understanding of all space needs, various organizations have tended to create systems that fulfill their needs alone. This has and will continue to result in cost and use inefficiency.

THE LEGACY

The U.S. space launch system faces serious problems with physical and technological obsolescence. The system consists of three primary space launch elements: infrastructure, ranges, and vehicles. Real property facilities and equipment of our launch bases built in the 1950s and 1960s--such as roads, rail, power distribution, water, sewer, roofs, toxic waste storage areas and environmental control systems for launch vehicle handling and processing buildings--are in need of repair or replacement. Natural decay, corrosion, and ocean salt spray have taken their toll. Inefficient range operations, architecture, and support capacity providing command, control and communications; telemetry and tracking; meteorological support; and safety systems and measures such as radar and command destruct mechanisms grew up from the individual collection of dedicated stove-piped weapon system testing requirements of the 50s and 60s into the range infrastructure we have today. These systems are obsolete and degraded resulting in frequent failures and a crisis of no source for spare parts. This makes U.S. range assets overly expensive to operate and maintain.[13] Also suffering age and design deficiencies, Atlas, Delta, and Titan launch vehicles, with their research and development ballistic missile heritage, have fared no better than range assets. Tied to an inefficient architecture— vertical integration on a limited number of launch pads and multiple upgrades to increase reliability and capacity—they have resulted in higher launch costs (Titan IV now costs $250-300 million/launch), longer processing times and less operational flexibility. The combined effects of these problems are already being felt in the form of launch delays, launch manifests over a year long, and ever increasing costs of operation. Consequently, systems continue to age in an era of constrained budgets with no coherent vision of where space is supposed to proceed in the next century. Assured, reliable, and affordable access to space has become more elusive.

The lost connection between space and ICBM operations is another example of an area that needs reform. In the past military Strategic Air Command (SAC) personnel

acquired ballistic missiles (Atlas, Titan, Minuteman, and Peace Keeper) through Air Force Systems Command. Military personnel then accepted missile components, stored, assembled, operated and maintained the missiles on alert as part of the U.S. nuclear deterrent force. Conversely, space launch operations continued as Research and Development (R&D) contractor operations with military oversight. With the changes in the world environment, SAC is gone, large numbers of the ICBM fleet have been demobilized, military personnel with launch expertise have been shifted to other programs while an entire contractor support system remains for launch operations. These shifts and changes have not been coherently applied according to any serious strategic vision that would exploit the best of both worlds, keep intact a system that prepares military personnel for future military launch missions in the 21st century and reduce costs, while eliminating obsolete infrastructure and systems.

From the 1950's through early 1980's, the United States enjoyed a virtual monopoly on the building and launching of commercial and military satellites on expendable launch vehicles (ELVs). DoD abandoned future expendable launch vehicles and relied on the shuttle because of an absence of a coherent and integrated civil and military launch vision and economic pressures to reduce projected Space Transportation System (STS) costs. The U.S., as one of only a few established spacepowers, built and launched almost 100% of the Western hemisphere's satellites. Commercial payloads back then were scheduled for the shuttle, as NASA sought to make the partially re-usable shuttle more economically viable by ensuring and projecting multiple uses per month. With the Challenger disaster in January 1986 and subsequent freezing of future shuttle launches for two years, U.S. access to space came to a virtual standstill which gravely impacted U.S. national security.

Policy makers, engineers, and scientists learned enormously valuable lessons from this experience. First, national security payloads and schedules had to be delayed or reconfigured for alternate launch vehicles if they could be found. Second, commercial

payloads were bumped for national security and military payloads—launch manifests exceeded two years and continue to be backlogged today. This forced commercial builders and users to look elsewhere. Non-market economies such as China and Russia, or the up and coming European and then Japanese space launch systems offered a way to fill the gap. Third, restarting the expendable launch structure would take years and be expensive. Since all future expendable launch vehicle (ELV) development had been cut, there was no future system in design—new systems would take a decade to field. Fourth, the U.S. could ill afford to be left with only one method of access to space. A corollary—manned space launch was always inherently more expensive ($/pound to orbit), more complex and thus riskier than ELVs. This meant the in-place but decaying and obsolete infrastructure had to meet a revised vision of spacelift. The U.S. had suddenly become noncompetitive in space launch capability.

CHAPTER 2

TRAPPED IN A DILEMMA

Current U.S. launch architecture is non-competitive, because American launch providers and satellite manufacturers maintain a research and development approach that prevents launch operation normalization—keeping U.S. launch vehicles difficult and expensive to process. Current space launch capability represents a patchwork of systems with tremendous cost inefficiencies. The U.S. employs a mix of manned and unmanned space launch systems. These are highly leveraged in terms of cost, schedule and efficiency by the shuttle decision and subsequent shuttle disaster. The current launch fleet is mostly expendable (Delta, Atlas and Titan families) with a partially reusable Space Transportation System (shuttle) providing manned access to space. The core vehicle technologies are 1950's and 60's vintage even though continual upgrades have stretched the operation envelope to its present maximum making each launch a one-of-a-kind R&D event. As a consequence, large standing armies of military and civilian personnel are required to support each launch. The Augustine Report of 1990, Aldridge Study of 1992, NASA's Access to Space Study, 1993 DoD Bottom-Up Review and 1994 Moorman Report all made recommendations to improve launch operations.[14] Only NASA's study advocated a reusable launch system as a primary recommendation. Status-quo, development of a new expendable, or mix of reusable and expendable launch vehicles were the primary recommendations by all others.[15] While these types of recommendations are bureaucratically safe, they are not the best answer to the nation's space needs.

The new U.S. procurement paradigm hopes to change the non-competitiveness of current launch architecture by reducing the time and costs of future launch. Driven by affordability issues, the Evolved Expendable Launch Vehicle (EELV) will introduce a new paradigm that avoids "performance at the margins" and associated high costs. United

States Air Force Secretary Sheila E. Widnall addressed this issue at the recent U.S. Space Foundation's national symposium. She stated that a new acquisition process driven by affordability issues will drive down EELV costs.[16] EELV modernization benefits government and commercial launch. This new paradigm seeks to suppress technical elegance in favor of cost-effective solutions, commercial specifications, minimal paperwork, and 30-day launch cycles.[17] This is a significant step forward but it must be integrated into a broader vision that takes more into account than simply launch vehicles.

The DoD-sponsored EELV is an immediate, interim, and necessary cost savings solution, but the NASA-led Reusable Launch Vehicle (RLV) offers the most potential savings. Successful EELV contract performance requires a standard payload interface for each launch class and a cost reduction of at least 25% over present methods. The RLV potential promises very low launch costs, rapid call-ups for "last-minute" satellite launches, re-manifesting without penalty, and reliable space access.[18] Many of these claims mirror statements made about the shuttle system which were never met. NASA envisions airline-like operations, horizontal processing of the payload and nominal seven-day turnarounds with a 2-3-day emergency call-up possible. Costs are estimated at $1.2K per pound to Low Earth Orbit (LEO) and $5K per pound to Geosynchronous Transfer Orbit (GTO).[19] A manned RLV is likely to weigh more, carry less, and be more expensive to operate than an unmanned RLV system. The EELV is seen by many as only an interim necessity for transition to technology that is ten years away. It is, however, likely to be kept as a backup capability long past its design projection like the B-52 bomber, that was designed for 20 years but kept in use for around fifty. NASA's RLV technology promises to give DoD and Commerce the most timely, reliable, cost efficient, and commercially competitive access to space. EELV today and RLV tomorrow are the right mix to avoid the consequences of another Challenger disaster.

MANPOWER: PART OF THE DILEMMA

The manpower equation continues to demonstrate a divergence of capability. ICBM operations are still military, and becoming much smaller as reductions of missiles under Strategic Arms Limitations Talks (SALT) and the Strategic Arms Reduction Talks (START) are accompanied by a reduction of units and military experience in operations and maintenance. A further reduction, consolidation and reorganization resulted at the end of the cold war in Air Force Systems Command (now Air Force Material Command) turning over space launch operations (Atlas, Titan and Delta) to Air Force Space Command. The spacelift mission is now accomplished by the 45th Space Wing located at Patrick Air Force Base and Cape Canaveral Air Force Station, Florida on the East coast and 30th Space Wing, located at Vandenberg Air Force Base, California on the West coast under the operational direction of 14th Air Force located at Vandenberg, Air Force Base. This shift has far ranging consequences.

Patrick Air Force base and Cape Canaveral employ approximately 3,500 military and 1,700 civil servants as well as approximately 6,700 contract employees to accomplish their spacelift mission.[20] The 30th Space Wing at Vandenberg Air Force Base also employs enough military, civil servants, and contract employees to accomplish a spacelift mission for unique polar and retrograde orbits not safely obtainable from the East coast. Together this accumulation of military oversight and contractor performance comprise an army of personnel necessary today to achieve both military and commercial access to space.

COMPETITIVENESS ESSENTIAL

In terms of competitiveness today, the U.S. ranks highest in cost ($lb/orbit) in

relation to Europe's Ariane, China and Russia; but ranks at the top with one commercial Russian exception in terms of probability of launch success. Russia and China can launch for approximately $4,000/lb to low earth orbit in part because they are highly subsidized non-market economies. Ariane's goal is to launch for $8,000/lb to LEO while the U.S.

costs of Delta, Atlas and Titan average between $12,000-14,000/lb to LEO. This places the U.S. at a severe commercial disadvantage at the exact moment when space access has become critical.

Cost is not the whole story. Complexity and time to receive, process, and launch the payload as well as access to a launch pad on the launch schedule are also major military and commercial concerns. A typical U.S. example of a satellite launch illustrates the complexity of the process:

> Space launch processing begins with planning for the arrival of flight hardware. Hardware can arrive via aircraft, truck, or even ship in some cases. Documentation is reviewed and updated to support the effort. Hardware arrives and is off-loaded at the receiving inspection facility. Once the hardware passes basic inspections, it is either stored or moved to a processing facility. At the processing facility, preparation of the hardware for launch begins. Build up and checkout takes place, various new checks are made to the built up hardware, and computer programming takes place. The hardware is moved to the launch pad and the spacecraft is mated to the booster. Destruct ordnance can be installed before hardware is moved to the launch pad or installed at the launch pad. Solid rocket motor boosters are also mated either just prior to the move to the pad (Titan) or while on the pad (Delta). Checks are conducted and the vehicle is basically ready for launch. This processing takes 35 (Delta) to 1 80 (Titan) days for a nominal timeline, but can vary considerably depending on how many modifications must take place for the specific payload being launched.[21]

A systematic analysis of this type of operation for the purpose of reducing time and saving money is vital for American competitiveness in space.

BACK TO THE FUTURE

The current political leadership has seen the need for significant change but often appears unable to select a direction. For example:

Last summer, the Clinton Administration crafted a national launch policy that

> takes a two-track approach. For the long haul, it proposes to develop a Reusable Launch Vehicle (RLV) that would drastically lower the cost of launching payloads to orbit. In the near term, U.S. launchers would be made more efficient by replacing subsystems with today's technology.[22]

New life and $2 billion over a number of years for the EELV will not be enough. The European Space Agency (ESA) spent over $6 billion to develop the Ariane launch vehicle. It has run out of money to continue, and is looking for additional roles for its rocket to recoup

some of the development cost. As a result, U.S. options include buying the Ariane launch vehicle production for the U.S., use it to launch Titan 4-class missions, and/or use a smaller version to launch Atlas class satellites.[23] While these possibilities offer attractive financial advantages, the central problem remains—U.S. policy prevents launching military payloads on foreign vehicles and suffers from the 'not invented here' mentality.[24]

The U.S. government has laid out very specific guidelines for preventing the creation of dependency on foreign space sources. It has clearly mandated that "U. S. Government agencies shall purchase commercially available space goods and services to the fullest extent feasible and shall not conduct activities with commercial applications that preclude or deter commercial space activities except for reasons of national security or public safety."[25] Even more important, Congress restricted the government from providing direct subsidies for commercial space purchases.[26] While these types of restrictions are understandable because of budget considerations, U.S. space launch policy still lacks a coherent process. The potential for conflict grows as numerous military, civil and commercial assets occupy two basic orbital locations, low and geosyncronous earth orbits. Due to the finite number of slots, high launch costs, and relatively small number of satellites needed for substantial Earth coverage at geosyncronous orbit, the trend is to build larger satellites or at least ones that hold more fuel. "[T]wo major new industry assessments cit[e] a sharp increase in both the number and size of new international communications spacecraft projected for development over the next several years."[27]

> The reports say that an average of more than 460 medium- and heavy-geosynchronous orbit communications spacecraft will be developed and launched through 2010. Although the reports cited no market financial projections, this level would be worth about $50-60 billion in commercially funded medium-heavy satellite and booster development around the world.[28]

This means there will be no relief from the demand for heavy launch vehicles and space access. Sounding the alarm, a recent report noted: "U.S. could lose its commercial viability to launch these new spacecraft unless it develops heavier launch vehicles, more comparable to the European Ariane 5, designed to place nearly 15,000 lb. in geosynchronous transfer orbit."[29] Even more critical if the U.S. doesn't take significant action by 2006 by developing larger boosters, "it could cede as much as 50% of the heavy communications spacecraft launch market to the Ariane 5, the Chinese Long March 3B and Russian and Ukrainian boosters."[30] Some efforts in international cooperation have been made: "The Russian Proton is tied with Lockheed Martin's ILS [PROTON international launch system] while the Ukrainian Zenit is tied with Boeing in the Sea Launch program"[31] Proton and Zenit have a 12,000-lb capability to geosynchronous Transfer Orbit (GTO). Recent forecasts of strong communications satellite development for geosyncronous earth orbit leaves the U.S. poorly equipped to compete. This demand will occur even though it is clear the current cost of expendable spacelift is high—from $4,000/lb to more than $12,000/lb to GTO depending on the country and system used. Reliable and competitive spacelift architecture is vital to the U.S.'s prestige as a world leader.

> The lack of affordability and responsiveness of the domestic fleet led to a comprehensive look at the nation's approach to space launch during 1993-94. NASA's Access to Space Study in 1993 concluded that low-cost, reusable single-stage-to-orbit boosters had become feasible and should be pursued. Lieutenant General Moorman's Space Launch Modernization Study examined several options to reduce costs and improve the operations of launch systems. A dual-track plan was suggested, in which: (1)'the DoD would "evolve" the current fleet of expendable launchers with the goal of reducing costs by 25% and, eventually, 50% over current values; and (2) NASA would embark on technology development culminating in an experimental reusable launch vehicle. Such systems might permit order-of-magnitude cost reductions and rapid turnaround on the order of days, approaching "aircraft-like" operations.[32]

The best American response to this problem is to find some form of affordable and competitive spacelift system.

OBSERVATIONS

The manpower question also clouds the future of U.S. space control. Some contractors have pointed to the large array of military and civilian oversight of the East and West launch complexes as additional reasons why U.S. spacelift is non-competitive, slow and costly. Some clarification on this issue is necessary. American decision makers have.

examined three approaches to the problem. (1) Commercial contracted services, (2) Cop on the beat military/civilian oversight, and (3) total military/civilian operations. A few trends help clarify the correct future path for launch operations personnel. First, it is difficult to be sure that if spacelift is commercialized any one company or group of companies will invest the amount of money needed to ensure future U.S. access to space. In time of war or crisis it's not clear what U.S. national access to space would be available. Although commercial efforts desire to be competitive in terms of cost, they rarely require immediate access to space as the government may for national security interests and objectives. Second, it is abundantly clear that military participation in space operations and control is growing, will continue to grow, and is here to stay. Just look at the Chairman's Joint Vision 2010, the Army's Full Spectrum Dominance vision and Air Force's Global Engagement vision. It is also clear that a cadre of military needs to be cultivated and protected for transition to future generation space operations. But that does not mean that all U.S. launch operations need to be military.

One solution is to have two launch pads, one East—one West coast, standardized operations manned exclusively by military for future military access to space and the continuation of military participation in NASA's manned programs. At the same time, parallel commercial EELV launch pads on the East and West coast could provide surge capacity by military operators in times of national need. However, total military launch operations structure does not make economic sense in light of present

and future U.S. domestic and economic realities.

These realities also cast doubt on current plans to continue use of the current fleet of U.S. launch vehicles beyond the turn of the century. The problem is that the continued production, operation, and maintenance of these vehicles is cost prohibitive for two reasons:

> 1) escalating expenses associated with inefficient launch schedules and their extensive infrastructure, and 2) outdated technologies, designs, and manufacturing techniques. Current national spacelift facilities, processes, vehicles, procedures and supporting infrastructure are not standardized, making each mission a unique event. Planned replacement of the current fleet of launch vehicles must begin now if the necessary technologies and system concepts are to be available early in the next century to support the needed modernization and improvements to the nation's launch capabilities.[33]

Current reality is that commercial requirements dominated by geosynchronous medium/heavy communications satellites need heavy lift, want low launch prices and dependable launch schedules—competitiveness.[34] U.S. forecasts most military payloads require medium lift—only a few military launches per year require heavy lift. This means that military priorities are out of step with a much larger commercial requirement. It is more likely that the commercial potential, now estimated at 31 heavy launches per year is a better indication of where the future demand will be for the globally expanding communications market even if technology drastically increases the reliability of current satellite components or reduces the size and weight.

America's inherent launch inefficiencies limit commercial launch providers from successfully competing in the international commercial space launch market. Rising recurring costs, stovepipe launch suppliers, reduced production and launch rates handicap American capability still further. A single family of heavy lift vehicles is the right competitive and operational answer for the future.[35] Government and industry cooperation in creating a vision, rebuilding infrastructure, and building the next generation of launch vehicles is vital for guaranteeing future U.S. launch

competitiveness.

CHAPTER 3

VISION REQUIRES LEADERSHIP & AUTHORITY

What the American military continues to do best is organize and lead when there is a clear objective. The United States military has a history of it and a destiny to lead when it is in our national interests. Just look at the difference it makes in any operation, warlike or humanitarian, when the U.S. military arrives on the scene. In a like manner, the Air Force, as the executive agent for DoD spacelift has done an excellent job of leading the development and stewardship of space. It has accomplished this despite the confines and limits of bureaucracies created within the United States Government, DoD and Air Force as institutions.

The central issue to ensuring the future of space access is having the leadership and authority to set clear priorities. Space now, more than ever, needs to be developed, husbanded, and protected so it has the opportunity to emerge from ancient parochial interservice, interdepartmental views, and the competing agendas of other departments and bureaucracies in NASA, DoT, DoC, and the Intelligence Community. In the future, the Air Force leadership may feel forced by roles, mission, and budget battles to leverage the present to acquire the next generation fighter, F-22 or advanced tactical fighter, in place of the funding required for access to space. General Fogleman, Chief of Staff of the Air Force, advocated that the Air Force may indeed become the Space and

Air Force or face the possibility of the creation of a fifth service. This obvious allusion to the position that the Army developed in the 1920s and 1930s when faced with "the potential of airpower" is matched by some Air Force leaders' indifference to the rise of spacepower. General Fogleman noted that this is changing with the growing acknowledgment that the U.S. must "not allow an adversary to control space."[36] However, even the military has been fragmented on this issue. In 1993 an Air Force report noted competition among space acquisition organizations such as the Air Force, Army, Navy, Ballistic Missile Defense Organization, Advanced Research Projects Agency, and National Reconnaissance Office

resulted in fragmented responsibilities, duplicate facilities, staffs, and infrastructures. These organizations were less effective by failing to achieve economies of scale, optimal existing capabilities, and validated operational requirements. In this instance competition resulted in non-interoperable space hardware and complicated operations.[37] This clouds the military's ability to provide a leadership role unless significant internal reform takes place. This will prove extraordinarily difficult in a period of downsizing where careers and force structure are at stake.

Another problem emerges when the rising need for commercial access to space is compared to military needs, According to the 1994 Moorman report:

> ...fewer satellites, with longer lives, perform more work, which has resulted in decreased launch rates and excess launch vehicle production and processing capacity. The accompanying negative effect is low, inefficient production rates that raise unit costs. In addition, a contributing factor to high vehicle costs is the frequent perturbations in launch schedules. For example, Atlas II and Titan IV program schedules have been stretched out 3 and 9 years, respectively. According to a Titan IV program representative, the program's stretched schedule increased development and procurements cost estimates by about $8.5 billion in then-year dollars.[38]

As a result, there is a negative impact on the ability of the U.S. to compete in the launch business. The DoD must work to solve fragmentation, duplication and compartmentalization.

EXECUTIVE SPACE POLICY PITFALLS

In spite of civil and military consensus on the need for a more cost effective launch system, lack of continuous executive branch focus and leadership has failed in the last decade to field a new launch system. The Bush Administration's policy had several problems. It did not address how his administration expected to provide effective management oversight for future space transportation evolution and development. This point is critical because of the government's prior poor experience in accomplishing this mission. The Bush Administration's attempts to solve the launch problem by simply

directing DOD and NASA to undertake the joint development of a new space launch vehicle has also essentially been judged a failure.[39] Examples include:

> ...failure of the administration and Congress to come to grips with the future course of space launch systems...[40]
>
> NASA does not appear to be able to afford to pay half the cost of the NLS (National Launch System) and DoD cannot afford to pay more than half...[41]
>
> At the same time, study after study within the administration concludes that current U.S. space launch systems and practices are archaic and non-competitive, which could have adverse economic and military consequences in the future...[42]
>
> NASA, together with the Defense Department and the aerospace industry, had spent nearly a decade defining and advocating a new launch vehicle program (which culminated in the proposed National Launch System), without being able to reach consensus with the Congress that it should be developed.[43]

ATTEMPTED SOLUTIONS

Vice President Quayle attempted to solve these problems with several suggestions in 1992. He advocated a review of space policy considering the end of the Cold War, decline in defense spending and aerospace industry cutbacks, impact of the federal budget deficits, revolution in space-related technologies, and recognition that space has become a critical element in America's war-fighting capability.[44] The Vice President understood that the solution to the problem rested in a clear vision and firm leadership. The review he sought provided some useful guidelines:

> The policy review resulted in three studies ending with the "Fink" report on the future of the U.S. space industrial base, the "Aldridge" report on the future of the U.S. space launch capability, and the "Wilkening" report on a post-Cold War assessment of U.S. space policy. The Wilkening report stated that the four U.S. space sectors -- military, intelligence, civil, and commercial--each have their own institutional culture that encourages overlap and discourages cooperation. Two major conclusions from these studies dealt with the need for (1) fundamental changes in the way government space activities are organized and managed and (2) a new, cost-effective space launch capability.[45]

This became the cornerstone for reform and the foundation for the recommendations to the new administration.

The recommendations call for the Clinton Administration to maintain a strong focus, make organizational changes that reduce duplication and encourage greater cooperation so that the next generation satellites are launched on a more cost-effective system early in the next century. This became the foundation for the Office of Science and Technology Policy, within the Executive Office of the President, which directed:

> DoD and NASA to cooperate, in pursuit of their individual responsibilities, to take advantage of the unique skills of each agency. DoD was to be the "lead agency for improvement and evolution of the current U.S. expendable launch fleet." NASA was to be the "lead agency for advanced /technology development and demonstration to prove the technologies requited for next generation reusable launch systems.[47]

This directive attempted to clearly establish responsibility lines between the two organizations.

After the separation of duties, NASA expressed willingness to cooperate with industry to regain American dominance in launch. However, NASA has been skeptical about industry's willingness to take the financial risks involved.[48] NASA Administrator, Daniel S. Goldin said: "I think you guys [Industry] lack the courage to step up-to the plate and make it happen,. . . I don't care whose feelings get hurt, I don't care which companies go under. We are going to deliver a vehicle at $1,000 a pound of payload to orbit, compared with $10,000/lb today."[49] Having set the goal and provided a vision, NASA was attempting to correct the deficit in planning for the future.

NASA's attempt did not receive the proper support from within the Clinton Administration. Space transportation policy still fails to establish effective management oversight with the authority to prioritize the multiple agendas and budgets within the executive branch performing space related acquisition functions. Past experience indicated that such a "mechanism is essential so that the executive branch and the various congressional committees responsible for space launch can better cooperate in making cost effective decisions on the future of national space transportation."[50] To some extent it appeared that the momentum gained in the closing days of the Bush Administration has been lost with the advent of the Clinton Administration.

CLINTON'S APPROACH

President Clinton believes that American leadership in science and technology has been at the center of our rise to world power status. He has advocated additional investment in science and technology to "drive economic growth, generate new knowledge, create new jobs, build new industries, ensure sustained national security, and improve our quality of life."[51] 1996 marks the fourth consecutive year President Clinton has raised the budget for investing in commercial science and technology.[52]

Two forces drive development: the economy and the government. The economy, by definition will follow market forces. This means that the government must provide leadership in areas that are vital to the nation's survival. The U.S. government must exercise leadership in investment in science and technology in areas where individual companies can not assume the risk of investment even though the public benefit is great and the private return is doubtful."[53] Clinton's 1997 budget call projected over $1 billion more than 1996 in R&D investment.[54] This means that while there is a transfer of dual use technology, the government must continue to exercise leadership as various agencies compete for a smaller piece of the pie. Space launch is critical to our country's health, economy and national security and should be improved by government R&D investing in the U.S.

Four years later the Clinton Administration's methods have not produced results. Space and access to it, a national asset, still does not have a clear vision that would address: (1) military, intelligence, civil, and commercial space launch requirements to achieve greater standardization across these sectors; (2) a process for centralizing oversight and decision-making to ensure interagency coordination and cooperation and elimination of duplication; and (3)\a funding mechanism to maintain program stability and meet the government's affordability challenge.[55] The first Clinton Administration did not effectively address the problem.

DUELING AGENDAS

The problem remains that different agencies have different agendas. This requires someone to lead while having the authority to make it stick. The Air Force wants to ensure it can obtain economical quantities of the next generation fighter, bomber, airlifter, and tanker to perform its core competencies. NASA wants to ensure it can continue the manned exploration of space and has the responsibility for building the next manned Reusable Launch Vehicle (RLV) to replace the shuttle. NASA also wants to maintain enough budget so that neither the shuttle nor the RLV will be the only scientific endeavor it can afford. This is where leadership becomes critical.

Department of Commerce also has an agenda. They seek to drive American industry to compete in the launch arena without regard to national security or commercial issues. Commerce believes that "the U.S. government is trying to press industry into financing the development of new commercial space transportation systems based on the notion that "if you build it, they (the customers) will come."[56] Today, the United States is the only government that does not directly subsidize its national launch system. The Europeans, Russians, Japanese, Indians, Israelis, and Chinese all do. So it is significant that U.S. industry is worried about taking the high financial risk associated with

developing the next generation launch system without government guarantees. The cost of long term leadership in space transportation will require the U.S. government to guarantee industry's return on investment, fund the advancement of space transportation technology and pursue the extension of commercial aviation regulations, infrastructure, and support systems to serve commercial space transportation.[57] When it comes down to it, commercial users don't want to pay for the on-demand access to space the military needs to ensure access to space. Growing commercial demand is and will continue to outstrip military demand.

Department of Transportation (DoT) has a space agenda. DoT would like all U.S. weather satellites consolidated under its umbrella. DoT also would like institutional ownership of the present NAVISTAR Global Positioning System (GPS) to ensure the safety and reliability of the transportation industry including a universal navigation aid for commercial air transportation.

> Governments around the world have recognized the power associated with transportation and, hence, have sponsored its development and advancement. In many places throughout the world, transportation infrastructure is government owned and operated. In the U.S., transportation is primarily privatized, but with significant federal aid for developing and maintaining railroads, highways, waterways, aviation, and other transportation infrastructure . . . The government has also funded weather forecasting and navigation means on which the transportation industry has become dependent for safety and reliability. A recent example is the development and deployment the NAVISTAR Global Positioning System (GPS) satellite constellation.[58]

DoT's interests may collide with military security and classification needs. As the line between military and commercial use of space continues to grow dim, non-military users will have a growing influence in the military use of space.

Customized launch sites in close proximity to other Atlas, Delta, and Titan sites can cause friction among competing contractors. Safety considerations slow down or hinder operations at adjacent launch sites. Numerous sites exist, limited to a couple for each specific launch vehicle class. For example, at Cape Canaveral Air Station, Atlas, Delta, and Titan use separate and unique launch infrastructures while the adjacent

Kennedy Space Center has multiple airstrips for the shuttle, NASA, and military aircraft. All of these sites need to be rationalized for maximum use and minimum redundancy.[59] DoT has an interest and should probably have an obligation to maintain part of the U.S. space launch infrastructure. However, the lines between user, supporter and supplier are not clear. In a commercial market, other government agencies should play a role in launch sites, but a single agency should be the coordinator.

OBSERVATIONS

Considering previous attempts, the Administration's current policy on national space transportation strategy still does not grant the authority at a high enough executive level to settle priorities among competing departments.[60] Focused authoritative executive leadership is a requirement for a national vision and essential to address the launch requirements for "national security, civil, and commercial space sectors; ensure interagency coordination, cooperation, and elimination of duplication; and maintain program and funding stability while meeting the government's affordability challenge".[61] DoD has not helped solve this problem because "space acquisition management responsibilities are fragmented among several organizations. . . Decisions on space acquisitions may be better served by more central organizational management. . . and by separate space appropriations that would include both the military and intelligence sectors.[62] Without some form of consolidation this fragmentation will be fatal to American efforts to be the leading spacepower.

To solve this problem the President should designate DoD as the unequivocal space launch priority among equals to ensure national security is enhanced. DoD should take advantage of the excellent military stewardship of space and continue to charge the military with developing a coherent DoD space vision and the leverage to coordinate interagency and interdepartmental disputes. DoT should take on the responsibilities and

modernization of the space launch range functions and sell services to DoD, commercial launches, and NASA as needed.

One often touted solution is to create a separate space service. A separate service is not what is needed here. The requirement is for codified guidance that ensures a long term space vision, stewardship and priority absent of administration changes and bureaucratic infighting. Defense needs rapid, efficient and cost effective space launch capabilities for warning, surveillance, communication, weather, and navigation missions from space. The Intelligence Community also needs rapid access to space for its present large and expensive payloads. Heavy lift is a top intelligence concern today. However, future technology trends, miniaturization and lighter payloads offer some hope of mitigating the problem. Even so, efficient and cost effective access to space will remain a priority. Space is vital to the needs of intelligence. It ensures information for Joint Vision 2010, information dominance, military operations, and the national security decision making process is available when needed.[63] NASA needs reduced shuttle expenses for cost effective reusable manned space flight. Commercial launch requirements dominated by geosynchronous communications satellites require heavy lift for medium-heavy satellites. Low launch service price and dependable launch schedules are the key to U.S. commercial competitiveness.[64] A separate space service would not solve these problems.

CHAPTER 4

FISCAL REALITY

Space launch requires a national commitment in terms of budget. DoD's annual space budget is in excess of $13 billion and almost 6 percent of DoD's total military budget today. "In addition to intelligence, over 75 percent of DoD's military space dollars are planned for communications, surveillance, launch vehicles, launch facilities, and satellite control. The remaining amounts are planned for navigation, meteorology, supporting research and development, and general support."[65] NASA is spending an additional $13 billion.[66] General Moorman's April 1 994 report stated, "DoD is faced with a predicament: a sizable investment is required in the near term to reduce costs in the long term, but the needed near-term investment may not be possible."[67] This means that agencies responsible for a portion of the mission should be given the budget to carry it out.

One advantage of a single American lead agency can be found in finding the best way to exploit Russian launch capability to make up for the deficit in our own ability. Most government agencies agree that:

> Russian launch vehicles and processes represent an untapped resource that could be beneficial to the United States. For example, the Moorman report stated that Russia possesses highly effective space launch systems and technologies that may provide attractive alternatives to domestic systems or technologies. The Russians have developed new launch vehicles; the Proton and Zenit medium-lift vehicles and the Energia heavy-lift vehicle are the latest. Russian engine technology is of particular interest to the United States because of efficiency, reliability, and an ability to vary the thrust. The Moorman report found that a detailed understanding of such technology could potentially lead to reduced cost for modernization. Although this technology sounds promising, it should be noted that the U.S. industrial technology base could be negatively affected by introducing Russian systems.[68]

Interagency cooperation with firm DoD leadership could exploit this situation but continued fragmentation will prevent significant advances.

In a significant shift from a policy that demanded independence of the U.S. space program from foreign sources, the Clinton Administration's national space transportation policy prohibits the government from purchasing space launch services from foreign sources, but it does not inhibit the use of foreign components or technologies in upgrading

or developing launch systems. This allows the government to take advantage of foreign technology within the constraints of national security, foreign policy, public safety, or law.[69] This shift will allow the U.S. to compete better in the international arena. The US effort must also address the issue of cost and timely launch.

> Some estimates place U.S. launch costs at twice that of the Europeans and four times that of the heavily subsidized Russians and Chinese. This erodes a dwindling military budget and drives U.S. commercial firms on to foreign lifters. In terms of response, it takes months on the pad to launch some satellites. Worse yet, the vast majority of our space launches do not meet their scheduled takeoff times, some are over a year late. Our ability to deliver a first class and competitive product internationally must be improved to retain an efficient space launch capability to meet military and commercial needs.[70]

U.S. launch non-competitiveness has forced the Administration to impede market forces and dictate to industry how much and when they can use foreign launch vehicles. "Under an agreement reached Jan. 30, [1995] China may conduct up to 11 launches of geosynchronous satellites for international customers through Dec. 31, 2001. The old agreement, which expired last year, was for nine launches over the previous six years."[71] The U.S. routinely threatens sanctions if non-market economies are caught selling launch services for less than the U.S. deems appropriate, thus protecting but not subsidizing U.S. launch providers.[72] "According to officials in the White House Office of the U.S. Trade Representative, the U.S. would review any Long March bid that is 15% below its lowest Western competitor."[73] Somehow U.S. trade representatives believe it is okay to force the competition to charge more and make more profit at the same time U.S. launch providers are idle. U.S. Trade Representative Mickey Kantor stated: "I believe this agreement carefully balances the interests of the U.S. space launch, satellite and telecommunications industries,. . .It will provide effective safeguards against disruption of the market for commercial space launch services while allowing for disciplined Chinese participation in the market."[74] The success of the U.S. space effort rests with our ability to mine foreign sources for useful technology.

While U.S. launch vehicle providers have lost market share, U.S. satellite building performance continues to increase.

> Over the last decade, satellites' economic performance (as measured by lifetime, power, band width and throughput) has improved by a factor of 25 because of space technology improvements and data compression techniques...Meanwhile, launcher efficiency has remained static. . .The result is launches and insurance now often cost more than the satellites. . . Ariane and Atlas vehicles are booked well into 1997, and disruptions in their schedules due to failures have ricocheted throughout the space and telecommunications industries.[75]

The satellite market is exploding while the launch provider industry continues to stack up the demand for affordable and reliable access to space. For example, the communication spacecraft market for the Asia/Pacific region through 2005 will climb to $7-10 billion or twice the U.S./European market. This will take place at the same time that predictions for booster availability will be declining.[76] Russia's SL-4 Soyus has failed twice consecutively, but is still booking "$1 billion worth of Western satellite launches on the Khrunichev Proton" as U.S. policy limits the Russians to 8 satellites to GTO.[77] Russia's spacelifters use a common stage and "flew 1 6 successful flights in 1995, 18 in 1994 and 25 in 1993... .An even stronger pace with few failures has been maintained for 25 years."[78] Since shortly after the Berlin wall came down signifying the end of the cold war, Russia has been very cooperative in sharing its space technology. "The Russian government now appears to have the attitude that it will approve a good business deal, and let the purchasing country select what it wants."[79] If only the U.S. had cooperated sooner, the U.S. might well be on its way to a new launch system and Russia might be in better economic shape. United States Government trade policy forces non-market economies that are willing to launch satellites for $40 million per launch to charge $70 million. At least the difference should be split with the supplier so that both the U.S. and French Ariane can invest the difference in future, more competitive, launch vehicles and infrastructures.

Today, and, for the foreseeable future, significant budget reductions resulting primarily from domestic "budget imperatives, as the nation tries to bring the deficit under control, and...a reduced strategic and conventional threat from traditional adversaries"[80] will

make it more difficult to implement space imperatives while holding the line on current service funding. The "vision that space is the ultimate high ground certainly underscores that it will undoubtedly play a more prominent role in the future...[of] our national security strategy."[81]

CHAPTER 5

CONCLUSION

> While past and evolving national policy has included specific direction on modernizing the Nation's space launch capability, little progress has been made due in large part to widely differing views and interests in this area and the inability to maintain consensus within the Executive Branch . . .While the civil and defense space programs are clearly separate and distinct, space launch is an area of common interest and interdependence that needs interagency [priority and direction] coordination.[82]

Lack of vision, authoritative priority, focus and national commitment has left he U.S. in a predicament—not enough funding in this austere budget environment to solve problems. New policy is not enough, real authority to back that policy is required. Lack of authority and organizational fragmentation wastes resources. All military space launch system acquisitions should be combined under a separate appropriation and a funding mechanism established to maintain future program stability.

Assured, reliable and affordable access to space will require continued active military leadership, national focus and commitment, and funding to ensure that United States national security is enhanced in the 21st century.

> As we look to the challenges of the 1990s and beyond, the essential ingredients that lead to an expanded role for space are coming together. The Air Force has clearly stated an aggressive space policy to guide its actions; technology has matured to the point that the tactical benefits of space systems can be readily available to our combat forces; and we have in place the organizational structure - a rapidly maturing operational command for space (Air Force Space Command) - to provide the stimulus and advocacy for new space applications.[83]

The United States must develop a coherent long term space launch policy that ensures affordable, reliable and assured access to space. It must build a mix of manned and unmanned space launch vehicles to guarantee U.S. present and future roles in space. The goal must be to support U.S. military and commercial requirements and ensure that the U.S. remains the world's leading spacepower.

RECOMMENDATIONS

First, the lead agency concept should be maintained to focus limited resources. Second, the U.S. should seriously consider building a heavy lift vehicle rather than a status-quo medium lift one. The projected annual commercial demand in the heavy category is triple that of military payloads. Even if technology reduces satellite size and weight, the U.S. should develop proficient capabilities to launch multiple medium weight satellites on one heavy booster to enhance surge capacity and timely space access. Commercial market launch volume should enable government payloads to take advantage of 'the savings. Third, Russian launch technology should be exploited to the fullest to make up for the deficit in our own abilities. Launches should be contracted for at the lowest possible rate and savings reinvested in future U.S. launch systems. Fourth, employment of a Russian work force should be considered in the initial building of the next generation of U.S. launch vehicles to save money on labor and keep scientists fed and employed. This will also reduce the number of Russian scientists employed by third world countries building weapons of mass destruction. Fifth, all military space launch system acquisitions should be combined under a separate appropriation and a funding mechanism established to maintain future program stability. Finally, to protect and focus selected joint budget issues in an austere environment, DoD should create a separate budget authority for spacelift, much like the funding for Special Operations Command. These special joint budgets should be reserved for functions or systems that clearly cut across the traditional Army, Air Force, and Navy roles and missions, and are of critical benefit to DoD's joint warfighting future. Under this approach any service could nominate systems or priorities that DoD would fund off the top of the budget before\individual services get their cut. Taken together, these recommended actions will ensure the' United States' dominant position in space well into the next century.

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