TOWARDS A NATIONAL SPACE STRATEGY

NATIONAL SPACE STRATEGY PROJECT

WORKSHOP REPORT

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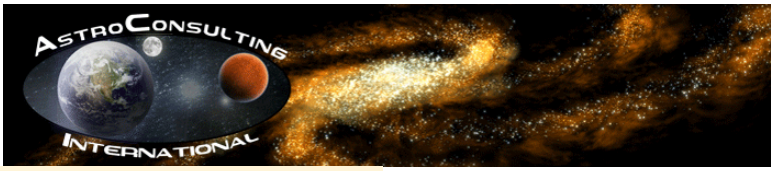

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NATIONAL SPACE STRATEGY PROJECT OVERVIEW

The National Space Strategy Project is an effort led by Astroconsulting International, The Secure World Foundation, The Space Policy Institute and the National Space Studies Center to identify and assess issues surrounding the development of a space strategy relevant to the United States Government (USG). This project endeavors to establish intellectual foundations and concepts that will enable an eventual strategy to be developed.

Over the last several years, multiple "blue ribbon panels" and commissions concluded that the United States needs a national space strategy. The purpose of strategy is to coordinate, integrate and prioritize the space activities of the USG across security, commercial and civil sectors. Without strategy, space activities continue to provide great value, but remain removed from the overall strategic picture of the United States and it becomes increasingly difficult to identify and execute long-term programs, projects and goals. Optimizing the use of space for security, economic, civil and environmental ends is essential, as dependence on and use of space is accelerating and space is increasingly integrated in the fabric of activities across all sectors.

This Project Report, *Towards a National Space Strategy*, summarizes the discussions and initial thoughts on developing a National Space Strategy for the United States generated by a group of experts who attended a workshop held 4-5 February 2010 at the Space Policy Institute in Washington, DC. A number of topics critical to development of a national space strategy were identified and divided into three parts.

1. Intellectual foundations.
2. Political challenges.
3. Specific issues that crosscut security, commercial and civil space, including: space launch capabilities; space program and project development; strategic management and capabilities; space industrial base; Earth observations; space assurance; space governance; and the implications of international space strategies.

The end products of the National Space Strategy Project will be a series of articles to be published in the journal *Astropolitics* during fall 2010 and chapters in a book in the Routledge series on *Space Power and Politics* in 2011. See **http://www.astroconsultinginternational.com** for relevant news releases, updates and progress on the National Space Strategy Project.

WORKING ASSUMPTIONS

A number of important reviews currently underway within the USG will impact national space policy. There is the Congressionally-directed Space Posture Review, the Presidentially-directed review of National Space Policy, the Quadrennial Defense Review and a review of national security space strategy. These efforts suggest that there is a window of opportunity to develop National Space Strategy for the USG. Several working assumptions were identified during the National Space Strategy Workshop.

1. National space strategy can either be formulated as an overarching grand strategy or as a limited strategy covering specific areas of concern and common problems that crosscut the space sectors. Both of these approaches have their advantages and disadvantages, and in either case, strategy provides guidance for the United States and the USG can use strategy to evaluate and hold accountable the various agencies that implement space programs and projects.
2. The USG does not suffer from a lack of National Space Policy, which is consistent and robust since the beginning of the space age. National space strategy provides a roadmap for connecting ways and means to achieve ends established by national space policy. In other words, strategy is the link between policy and programs.
3. National space strategy development must advance on the basis that resource constraints and flat budgets for space programs and projects will be the norm. Within this context, space strategy development needs to account for how best to deal with gaps between policy, programs, projects and budgets. For national space strategy to be effective, it must serve as a guide to allow for decisions on requirements, budgets and operations, and for trade-offs that are necessary given resource constraints.
4. A "whole-of-government" approach is critical for national space strategy development. In addition to a focus on hardware development, capabilities and operations, this approach addresses issues across security, civil and commercial space sectors and considers regulatory, diplomatic and legislative factors.
5. Space users share a set of basic strategic goals: to secure the space domain for everyone's peaceful use; to protect legitimate space assets from various types of threats; and to derive value from space assets for security, economic, civil and environmental ends.

It is important as well to avoid common pitfalls in the process of developing strategy.

- Failing to take a whole-of-government approach and instead fixate on governance, implementation and optimization issues.
- Failing to recognize and take seriously scarcity of resources.
- Mistaking goals for strategy.
- Failing to recognize strategic problems and to define the strategic environment competitively.
- Choosing poor or unattainable strategic goals and objectives.
- Making false presumptions about one's own competence or the likely causal linkages between one's strategy and one's goals and objectives.
- Insufficient focus on strategy due to such things as trying to satisfy too many different stakeholders or bureaucratic and programmatic processes.
- Failing to understand threats and adversaries.
- Inaccurately determining one's areas of comparative advantage relative to the opposition.
- Failing to realize that few individuals possess the cognitive skills and mindset to be competent strategists.

PART I: INTELLECTUAL FOUNDATIONS

What is Strategy?

The project begins with a discussion of definitions of strategy and how strategy applies to USG space activities.

The question of what is strategy is difficult to answer. Strategy does not necessarily solve USG problems related to the uses of space, especially strategy that cannot be accomplished politically within a reasonable timeframe. At the same time, national space strategy must focus on the entire range of space activities and move away from the tendency to solely address military and security related space activities.

Since the beginning of the space age, there were a number of attempts to formulate space strategy.

- The Eisenhower Administration formulated a policy of "open skies" for the overflight of space assets in Earth orbit, yet failed to link this policy to the larger strategic interests of the United States
- The Kennedy Administration supported the Apollo program within the context of the Cold War, a development which came close to looking like a strategy
- The Carter Administration emphasized the on-going USG commitment to the peaceful uses of space, but did not link this to other U.S. strategic and foreign policy interests
- The Reagan Administration put forward a means for developing commercial uses of space, but did not tie this to long-term economic and industrial goals
- The Clinton Administration linked space to international cooperation in the post Cold War international environment, but did not address how and why space activities, like the International Space Station (ISS), are linked to broader interests of cooperation
- The Bush Administration focused on space like other domains of national power, such as air, land and sea, but provided no linkage among them and no management or governance of the international problems related to uses of space.

Other starting points for space strategy concern the various intellectual constructs that exist.

- John J. Klein's work, *Space Warfare: Strategy, Principles and Policy*, which applies maritime strategy to space.
- Everett C. Dolman's *Astropolitik: Classical Geopolitics in the Space Age* that puts forward a geopolitical approach for space governance with the United States as the dominant power for ensuring the norms and management of space.
- Bruce M. Deblois' *Space Sanctuary: A Viable National Strategy*, which argues for a commitment to the peaceful uses of outer space and space as a global commons for free use and access, and not space control or dominance.
- Detlev Wolter's work on *Common Security in Outer Space and International Law* that advances a framework for multilateral, international governance of space.
- Joan Johnson-Freese's *Space as a Strategic Asset* that offers a "soft power" strategic approach to space.
- James A. Vedda's recent work, *Choice, Not Fate: Shaping a Sustainable Future in the Space Age*, which suggests an "Earth-centric" strategy, i.e., using space to benefit life on Earth.
- James Michael Snead in an article in *Astropolitics*, "Spacefaring Logistics Infrastructure," that focuses on the longer term and is more economically oriented to space industrial development.

The issue of how to create a more effective strategy is essential to address. In this regard, there are a number of factors.

1. Develop consensus around a common theme.
2. Account for the reactions of other space actors and spacefaring states.
3. Mitigate resource constraints by prioritizing space within the USG and by stimulating private sector development.
4. Provide for sustainable uses of space and effective space governance of common problems, such as orbital debris, and spectrum and orbital slot allocations.

Strategy for What?

In what ways can strategy link means – space capabilities – to ends, i.e., secure the space domain for peaceful uses, protect space assets from threats and derive maximum value from space assets for security, economic, civil and environmental ends? The identification of gaps and disconnects between national strategy and national policy is considered as well.

Strategy links power to purposes, serves and fulfills policy and provides a means by which to prioritize the uses of space for maintaining advantages for the United States.[1] Clearly, the formulation of strategy is beneficial to the USG, yet as strategy is established, the United States needs to support as well the development and education of strategists across all the various disciplines applicable to space.

A National Space Policy is something that every U.S. Administration since Eisenhower has formulated, but the notion that this policy serves as strategy is incorrect. Further, creating a strategy is not an easy task as it must serve broader and more diverse interests than policy. Most of the attempts at space strategy are not really strategy. In fact, strategy rarely informs us on how to get from where we are today to where we want to be in the future, especially in light of rapid developments in technology and politics. Since there is the necessity to constantly adapt to changing circumstances, strategy development is more of a mindset and way to think than anything else.[2]

There are a number of challenges to consider in addressing the purposes of strategy.

1. Strategy has diverse components and interests, which are sometimes conflicting.
2. Strategy must serve multiple and diverse constituencies.
3. Strategy is about the future, which is unknowable and unpredictable.
4. Strategy should account for all doctrinal options – from dominance to institution-building – and apply whatever is appropriate at the time.
5. Strategy is counterintuitive and paradoxical, e.g., in order to maintain our technological edge, we need to increase competition and reform export controls.
6. Strategy is only as good as the strategists. The development of strategy must be accompanied by the development of people who will implement strategy and will make strategic choices.

[1]Power in this context can be thought of as spacepower, which is the ability to exert influence in or from space in all conditions ranging from peace to war.

[2]One key conclusion to draw from the Augustine Commission that assessed space exploration approaches for civil space in the United States is that there is not enough money to get to where we said we were going – i.e., the U.S. Space Exploration Policy of the Bush Administration. This is symptomatic of the poor state of strategic thinking.

Intellectual Foundations: Discussion

There are many groups and individuals, both inside and outside the USG, that think that the United States will benefit from space strategy development, yet it is very difficult accomplish. The problem is that strategy links policy to broader goals and objectives and there is no defined, consensus on these ends to force the United States to make the necessary trade-offs when creating strategy. Of concern, is where does the motivation come from for space strategy, how can we draw attention to strategy and how can strategy help preserve and advance U.S. capabilities and advantages?

Consensus that strategy is necessary is not sufficient for its formulation and implementation, as there is also the need for political will and a process for strategic thinking. Political will is essential to define strategy, which is ultimately about what you want to do, i.e., what policy and political interests do you want to serve and fulfill. A process for strategic thinking can break down "stove pipes" and make interests more transparent among constituents to facilitate strategy development. Strategy is not about publishing a document, but rather is a way of thinking – a common language and framework – that allows for the realization of policy and political interests.

An additional consideration in the development of strategy is to draw lessons from history. Since strategy links power to political purpose, it is critical to examine analogies of power by advances in technology and strategic projection in different domains, i.e., land, sea, air and space. History demonstrates that technological advantages are temporary and short-term and that dominating a domain takes time and strategic thought, and the ability to adapt successfully.

PART II: POLITICAL CHALLENGES

Formulation and Implementation

Is an overarching strategy that focuses on the interrelationships between security, commercial and civil space most effective or should it be linked to the specific areas of interest to each space sector? The analysis of formulation considers interagency decision making and coordination. The investigation of implementation examines: alignment of strategy, policy, space programs and projects, and budgets; coordination of budgetary guidance and responsibility and accountability across USG organizations involved in space activities; prioritization of actions and interactions to implement strategy by and within organizations of the USG, including the effectiveness of organizational structures, span of organizational control and legal authority; and political and organizational means to address revisions and updates in strategy and to mediate political disputes and conflicts in the implementation process.

An overarching approach to strategy, i.e., grand strategy, though desirable, is not feasible given political realities. The political challenges in developing strategy make a more focused or limited approach to strategy more plausible. Such an approach would likely focus on common problems facing security, commercial and civil space.

Strategies tend be reactive, not proactive. The political process elevates crisis to be the driving force behind policies. For example, the Vision for Space Exploration, conceived under the Bush Administration's U.S. Space Exploration Policy in 2004, was largely driven by the Space Shuttle Columbia disaster. Given the reactive nature of the political system, is a broad scope encompassing all aspects of space appropriate for strategy development? Or, should the USG focus separately on sector-specific or issue-specific issues, such as access to space, remote sensing and space infrastructure? In practice, national space policy tends to focus on broad cross-cutting trends and problems, while strategies are developed to deal with more specific issues.

Concomitantly, it is vital to focus on processes of formulating and implementing strategy and the attendant policy, planning and budgeting factors. It is essential to avoid overreaching with strategy formulation and underperforming with implementation. Prioritization and trade-offs, given resource constraints, are impediments to successful implementation, especially in light of entrenched interests among agencies and bureaucracies that are tasked with implementing programs and projects. Further, budgeting is at the heart of implementing a strategy and there is the challenge of meeting the interests of the many stakeholders in the space arena. The tendency in meeting stakeholder demands is to either overreach with the complexity of the system under development or to adopt approaches that seek the lowest common denominator approach, both of which lead to underperforming with implementation.

Without top-level commitment and direction, and common interests that crosscut the implementing agencies and the space sectors, year-to-year budget battles will dominate implementation. A strategic framework is essential to guide top-level decision-makers and to maximize mutual benefit to agencies so that their interests are to work together. Agencies like to preserve flexibility, so broad policy statements are generally acceptable to them. In the case of strategy where budgetary decisions are relevant, agencies are less reluctant to cooperate unless there is common benefit and interest.

Political Challenges: Discussion

A more narrowly drawn strategy on specific issues, such as ensuring the long-term sustainability of the space environment, is certainly more achievable in the political environment that exists. Yet this approach to strategy, posits the danger of continuing to stove pipe programs and projects that many recognize as a serious problem in the space field.

There are a number of important issues to consider when thinking about political challenges. Is the end to be achieved by strategy clearly understood by the stakeholders, do the stakeholders all agree on the end and do they all know their role in accomplishing it? How much money is available to accomplish the programs and projects called for in the strategy and for how long? What are the legal issues and implications – do boundaries need to be changed as to how agencies implement and cooperate? Do other stakeholders, like the U.S. Congress, complicate or simplify matters? How do we bring our allies into strategy and what is their role in formulation and implementation? And, how does strategy affect our commercial space infrastructure?

There are issues as well with the process that leads to strategy. Ideally, there should first be policy formulation, then strategy directed at how to fulfill policy, followed by plans and finally budgetary allocations to implement plans. In practice, all this is reversed – i.e., the budget is first, then strategy is developed usually at the agency-level and lastly a policy is put forward. This leads to strategies that less than optimal and that fall short in providing top-level guidance and commitments that are essential. Moreover, as the budget begets the rest of the process, the role of the U.S. Congress in appropriating budgets complicates matters.[3]

Despite the political challenges, there is value in establishing a process for national space strategy development. To illustrate, the process used to develop broad, national military policy is useful. The Quadrennial Defense Review of the U.S. Department of Defense (DOD), even if it does not advance major changes, is useful for consistency, for engaging people who are informed in the issues and for keeping them in the mindset of policy formulation. Even if the final policy document does not have lasting impact, the process alone is valuable. Drawing on this example, a plausible approach for space strategy development is to establish a process to accomplish this end within a National Space Council in the Office of the President of the U.S.

[3] Matters are further complicated by the fact that there are many stakeholders in Congress and you have to deal with them one at a time. Unless a member of Congress serves on multiple special interest committees, there are no ideal outcomes to appropriating budgets for agencies and programs.

PART III: CROSSCUTTING ISSUES

Security, Commercial and Civil Space

The traditional boundaries between security, commercial and civil space are no longer applicable for many space activities that crosscut these sectors. What are the most optimal uses of space capabilities and resources – budgetary and organizational capabilities – for the ends of securing the space domain for peaceful uses in the realization of security, commerce and civil pursuits? What is the extent of the convergence among the space sectors? What are the benefits and constrains in working to operate cooperatively across the security, commercial and civil space sectors?

How and in what ways can strategy address the fact that the traditional boundaries between security, commercial and civil space are no longer applicable for many space activities that crosscut these sectors?[4] The organizational structure of U.S. space activities into distinct sectors – security, commercial, and civil – is a legacy of U.S. history in space, which is not particularly conducive to the innate dual-use nature of space. Strategy and unity of effort across the space sectors are needed to best make use of dual-use capabilities as well as to best protect space assets.

One essential component to develop strategy and unity of effort is to secure the attention and commitment from senior decision-makers, such as the President and key members in the Administration and Congress. In the past, space strategy has been developed, so it is plausible and feasible to do so, although the execution of such strategy is more difficult.[5] In many ways, space is seldom a stand-alone policy area for the USG and is usually a subfield of some other foreign policy or national interest. Given this, interest among senior decision-makers can be developed when space is used as a means for some other policy end rather than a goal in-and-of-itself.

It is worth considering the set of common issues and concerns that can provide for strategy and unity of effort among the space sectors. Security space posits the most difficult of the sectors to come up with a unifying vision and strategy. Although there are approximately twice as many resources committed to security space compared to civil, there is no single organization with security space as its job. It is further interesting to note that DOD does not have a unifying vision or mission statement for all space activities. For example, the U.S. Air Force's (USAF's) vision to "fly, fight and win in air, space and cyberspace" is very different from the National Reconnaissance Office and National Geospatial-Intelligence Agency vision statements. This suggests that an essential ingredient for unifying security space lies with organization and management of that sector.

In this vein, there is a need for a dedicated organization in the Office of the President that is supported by people from stakeholder organizations that can integrate the National Security Council's and Office of Science and Technology Policy's work on space. Also, there is a need for standing, high-level decision-makers in the Intelligence Community and in DOD – for example, an Under Secretary of Defense for

[4]For example, the commercial sector carries 85 percent of military telecommunications traffic, and all the Unmanned Aerial Vehicles flying are on commercial UV-band traffic.

[5]Peter B Teets assembled a national security space strategy in 2004 when he served as Undersecretary of the Air Force, Department of Defense Executive Agent for Space, and National Reconnaissance Office Director, but the strategy was delayed for political reasons and the strategy was never released.

Space and Deputy Director of National Intelligence for Space to be supported by a standing integrated office for space. The reconstitution of a unified combatant command for space could help with unity of effort.[6] Lastly, the USAF should consider going back to the 1961-2005 structure where the Director of the National Reconnaissance Office is dual-hatted as Undersecretary of the Air Force to better integrate military and intelligence-gathering uses of space.[7]

With commercial space, the issue is about creating a true marketplace.[8] But due to national security concerns surrounding space technology, companies have to deal with the USG, which has not been consistent in regulating and working with commercial entities. At times, USG policies impose barriers to commercial space, such as with export controls, and at other times, there are approaches to foster commercial space development. National Space Policy emphasizes the latter and as such a space strategy would need to address how that policy can be realized.[9] Key components would likely include: a level playing field for new and emerging space commercial endeavors;[10] long-term consistency in government policies, laws and regulations; and economic incentives.

In the area of civil space, there are shortcomings in a unifying vision within the sector and with the other two sectors. The one advantage for the civil sector is that a single organization, the National Aeronautics and Space Administration (NASA), is the predominant player. However, NASA has struggled with defining its own vision, strategy and long-term goals since the successes of the Apollo era. Perhaps, more emphasis on improving and protecting life on Earth working with the security space sector and operational capability working with the commercial sector are ways forward for greater unity of effort.

Security, Commercial and Civil Space: Discussion

At issue for greater cooperation and unity of effort among the space sectors, is to identify and emphasize the mutual and common benefits that each sector can derive from space and to work to lessen the barriers between the sectors that disrupt cooperation. Space launch is one key opportunity for cooperation among the sectors.

An important element to cooperation is to understand the vital interests of each sector. Security space – consisting mainly of the DOD and the Intelligence Community – is focused on missions of collecting data and defending for national security; civil space – mainly NASA and the National Oceanic and Atmospheric Administration (NOAA) – is focused on technology development and innovation for science, operational capabilities and exploration; and commercial space focuses on return-on-investment and profit, and forms the space industrial base to build and provide space services and assets to the other sectors.[11]

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[6]Air Force Space Command functions within United States Strategic Command where space does not get enough attention. A dedicated U.S. Space Command would be a better way of integrating space capabilities across services.

[7]There is an ongoing study by the Air Force about how to manage governance issues.

[8]Commercial space companies do have strategies, but face an insufficient marketplace to realize strategy.

[9]Public-private partnerships are one way for government to advance commercial space. For example, commercial satellite companies are engaged in on-going discussions with the Department of Defense on how to more creatively provide commercial services to meet military needs.

[10]When we talk about a level playing field for commerce, for much of the rest of the world, it is about generating revenues, and it does not matter whether it is the government or a private entity that is doing that. In many ways, there is a false government/private dichotomy.

[11]There is a difference between a "commercial entity," which is something that sells something to other commercial entities in a marketplace, and a contractor to the USG.

There are a number of additional issues to consider in promoting and enhancing cooperation among the sectors.

1. Most of the major space programs and projects in the United States are in trouble as to cost and schedule. This situation necessitates a careful consideration of how best to make use of dual-use technologies and approaches.
2. We have had strategies with clarity of purpose – for example, the 2004 Vision for Space Exploration for human spaceflight to the Moon was a civil space strategy – that have failed due to cost and lack of political commitment. Further, it is worth recalling that in 2004 a National Security Space Strategy was developed and not released.
3. U.S. space assets and commercial space assets collect vast amounts of data. The issue here is how best to manage and make effective use of the data for strategic purposes.[12]

[12]There is the problem of managing and governing more effectively the congested space environment by providing space situational awareness for traffic management and orbital debris mitigation. Also, there exists frequency crowding with more and more unintentional jamming as well as intentional jamming, some of it state-sponsored. As these things are going on, there is no real way to communicate between private entities and the government on better spectrum management. And sharing information across sectors is an issue in the cyber realm – e.g., one company may know if it has been penetrated, but there is no way to know if it is an isolated incident or if it is widespread Thus, data sharing across all these concerns is an area that can promote multi-sector cooperation; how do we share information about what is going on in the most efficient way possible? One example of data sharing lies with commercial satellite operators that are cooperating to share space situational awareness data working in parallel with the gathering of such data by the United States Air Force Joint Space Operations Center.

Space Launch Capabilities

Space launch capabilities are foundational for achieving strategic ends. What are the costs and benefits associated with space launch, and how can the development of national strategy address the challenges of access to space? Goals, demands, capabilities, resources and services of the security, commercial and civil space sectors in relation to space launch capabilities are considered here.

In the context of thinking about space launch capabilities and strategy, it is important to identify the various customer groups for space launch.

1. *National Security Space* demands space launch capabilities for large-scale platforms with high cost value, such as reconnaissance and early-warning systems. This customer group needs high-reliability foremost, e.g., assured access to space, and it is not as sensitive to cost, schedule and prestige.
2. The *Operationally Responsive Space (ORS)* group, which contains tactical and battlefield users, requires specific, on-demand capabilities in a very short time period.
3. The *civil robotic* customer group is driven by the need for long-term schedule assurance and high-reliability more so than price.
4. The *civil human spaceflight* group is a high-prestige area.[13] High-reliability and launch weight is essential and expense is secondary.
5. *Established commercial entities* as a customer group for space launch of communications and remote sensing satellites are interested in high-reliability and schedule assurance. Cost is more secondary to these concerns and prestige is not an issue for this group.
6. The *new, emerging commercial space* group, which is focused on space tourism and other new launch vehicle development, is very sensitive to both cost and high-reliability. These ends of lower cost and high-reliability are critical to make their business case close. This forces trade-offs with schedule assurance and also leads companies within this group to develop in-house capability, rather than out-source hardware development.

The key conclusion to draw from this survey of space launch customer groups, and a key implication for space launch strategy, is that cost is not the driving issue for most customers. This conclusion contradicts the common focus with space launch on reducing cost per kilogram to orbit. In reality, lower launch costs only directly affect ORS and space tourism, the much newer and smaller entrants into the field. Lower cost is also complicated by the fact that barriers to entry for space launch make launch costs less elastic than for typical commercial industries.

The key requirements for most customer groups and the ones that dominate the environment today are high-reliability, assured access and schedule assurance to meet launch windows and to meet commercial demands. These requirements served as the basis for the development of the Evolved Expendable Launch Vehicle program in the United States. Although the launch systems in operation may not be ideal, they meet the needs of the customers.

There are a number of issues and questions a space strategy needs to address in relation to space launch.[14] Since the long-time focus on cost has not really been that appropriate, what happens if a

[13]The prestige factor may not be enough to compensate for the high costs and additional time needed for development of human spaceflight systems compared to unmanned launch systems.

[14]There were some differences of opinion in whether or not space launch as a stand-alone strategy is appropriate. Some felt

significantly cheaper launcher comes along? What is the role of government in space launch and how much support is required for commercial space launch?[15] What incentives can the government provide? How much demand is needed to sustain multiple launch systems?

Space Launch Capabilities: Discussion

In relation to the space launch customer groups, the tasks of orbital satellite deployment and suborbital tourism are much different. Is there a need to delineate these two tasks – to provide a clearer definition, description and summary of needs and capabilities for orbital versus suborbital launch vehicles? Is it appropriate to consider both together in space launch strategy development?

The issue of the space launch workforce is critical to take into account for strategy, including the cross-functions of commercial, military and private workforce issues. For example, as the USG moves to some type of Space Shuttle replacement system, thousands of people that constitute the Shuttle workforce will be let go. Other key factors for strategy are the issues of a government role and out-sourcing space launch on a commercial basis. In doing so, it may be prudent to keep the Space Shuttle flying as a transition, or possibly continuing with elements of Project Constellation, so that the risk is brought down to some degree and there is an orderly transition to commercial launchers to meet governmental needs.[16]

There also exists a newfound USG reliance on foreign launchers for human spaceflight in light of the forthcoming Space Shuttle termination. In this regard, how do foreign launch capabilities and foreign launch competition affect space launch strategy?[17] Clearly, export controls and International Traffic in Arms Regulations (ITAR) is in play when you consider space launch strategy. There is the associated issue of a gap in human spaceflight capabilities for the USG from the time of the panned termination of the Space Shuttle to the time that a replacement system becomes operational. This gap is more critical than many think, especially with regard to foreign policy and national security, and in launch vehicle considerations and options. How and in what ways should this issue of human spaceflight play into strategy?

The conclusion that space launch cost is not the most important factor is valid. In practice, even at

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that an exclusive space launch strategy is not plausible, while others view space launch as a good candidate to develop a specific space strategy given that the issue cross-cuts and is common to all the space sectors. Of note when thinking about space launch strategy, is that there exists a U.S. space transportation policy. See U.S. Space Transportation Policy, 6 January 2005, http://fas.org/irp/offdocs/nspd/nspd-40.pdf (accessed March 2010). The President authorized a new national policy on 21 December 2004 that establishes national policy, guidelines and implementation actions for United States space transportation programs and activities to ensure the Nation's ability to maintain access to and use space for U.S. national and homeland security, and civil, scientific and commercial purposes.

[15]In most foreign states, government ownership of commercial space launch is common. In the U.S., there are shared approaches where the government pays for much of the cost for high-reliability and assured access, while some of the operational costs are borne by industry.

[16]An issue here deals with how you transition from contractors building a new capability for government from relying on the commercial market for government space launches, assuming the USG moves in this direction as is advocated by the Obama Administration. Possibly, the proposed cancellation of Project Constellation in the U.S. is an opportunity to hand-off human spaceflight to a nongovernment, commercial entity.

[17]Europe, for example, does not have the same government satellite output as the United States, yet 85 percent of European space launch revenues come from launching commercial satellites. Further, there are nine GEO (geosynchronous Earth orbit) capable medium and heavy lift-class vehicles in operation today and seven more in development worldwide. There is more space launch service available worldwide than demand for that service.

current levels, space launch cost is a small percentage of the total costs of developing, building, launching (fixed costs of launch infrastructure) and operating space vehicles. Further, launch costs are not elastic. To illustrate, when the space launch market declined in 2003 and launch cost dropped by 50% or more, the demand went nowhere.[18] All this is complicated by the fact that space launch is not a commodity; it is not a free market with many providers and consumers, and a high volume of transactions. Furthermore, the timelines for the launch business are two to three years from contract to launch. And for developing a new launcher, the timeline requires that you predict what the market will look like 10-15 years from now and what will be the state of technology and the demands of the customers along the way. One key trade-off here is between investments for new technology development to the next generation or use of commercial off-the-shelf technologies where you develop based on the state of technology today.

Cost, schedule and performance are the three elements for trade-off for launch vehicles. In practice, only one of the three can be optimized and customers, by and large, focus on optimizing performance. This is all the more valid given that the entire launch market is essentially comprised of national security and commercial communications customers. Other players, like those dealing with ORS and space tourism, might prefer other trade-offs.

It is important to keep in mind that the various customer groups have different requirements in terms of reliability and safety as well as weight and launch schedule, which will dramatically affect the price and requirements for each. This posits an issue if, and when, commercial launchers designed for unmanned payloads launch humans into space. The character of a government-private relationship that does this is going to be very different from the current set of relationships for space launch.

The inability to pick a propulsion system can cripple launch infrastructure as producing rocket fuel takes time and money. The propulsion issue is a crosscutting one that a strategy should consider. For example, the proposed cancellation of Project Constellation will have large impacts on national security space because the reduced demand for solid rocket fuel.

[18]Part of the lack of elasticity was that it was short-term. The drop in 2003 only lasted a year and no one could develop a new payload quickly enough to take advantage of this. With other sectors, this might not be the case. For example, you could have an influx of space tourists taking advantage of future price drops.

Space Program and Project Development

The development of space programs and projects is foundational to the capabilities that the USG can bring to bear to achieve strategic ends. Yet program and project development is beset with budgetary and schedule challenges. This context of development constrains USG organizations to eliminate gaps and unnecessary duplication in the space sectors and to coordinate resource allocations for common services and technical infrastructure. The impacts of acquisitions, program and project requirements, budgets and operations of space systems on the development of space capabilities are examined.

A national space strategy needs to integrate the needs of national security, civil government and commercial customers when it comes to developing space assets, capabilities and infrastructure. The absence of strategy has yielded the "less money, more mission" environment we find ourselves in today. It leaves the United States vulnerable to damage from year to year as the budget swings up and down. The USG seems to react from crisis to crisis and in the process more of our leadership erodes. The space community needs to acknowledge the challenges that exist and develop a sense of urgency, resolve our requirements and priorities, and execute. A space strategy can help us do all this successfully.

The challenges today are greater in number and more varied in severity than in the past. Some of the challenges include: conventional and unconventional threats; asymmetric warfare that demands new capabilities; cyber security moving to a higher priority; "low-end actors" in terms of resources with access to high-end capabilities; contractors that can successfully execute on programs and assume some of the research and development (R&D) and financial risks to allow current and developing technologies to be delivered; cost and schedule overruns;[19] delivering less than we promised or failing to meet our commitments; and high-end capabilities at too high of a price.

These realities are playing out against a backdrop of significant delays for decisions and acquisitions, making the entire process that much more difficult. Further, the needs of our customers have shifted dramatically. On the nongovernment side, there is market uncertainty, difficulty in finding financing and the threat of substitution. Government can play some important roles as financier, risk-reducer and first customer. But there is also a tendency to gravitate towards the "quick fix" through streamlined acquisition, acquisition reform, fixed-price development and international collaboration. The reality is that some risk is not manageable in these ways.

National space strategy needs to be sufficiently enduring and compelling in the face of these difficulties and others. But moving toward the long-term view on space would be one step. Space programs are difficult to execute and easy to derail. In space program and project development, you have to get everything right the first time as there are no recalls or second chances. Many systems are one-of-a-kind science experiments or exquisite operational systems. There is a potential of significant wasted resources and failures are seldom benign. The environment of program and project management has been punishing of failure and credibility is fragile. There are as well many small, specialized component providers, but very few large proven system level consolidators or prime contractors.

Generally, space systems live to be two to three times their design life – if they get past launch and the

[19]The USG cannot tolerate these overruns; for example, the Secretary of Defense has made clear his position on program discipline and the penalty for failure.

initial infant mortality period – which is a product of the focus on quality and reliability. Building constituencies for systems typically involves overpromising in terms of exquisite capabilities or quick fixes. And the annual budget process only makes matters more complicated. Resources are in demand, people want to buy just in time and large risks are placed on reliability. Vehicles are also purchased one at a time, which places risk on the supply chain. Fixed pricing can work for both sides, contractors and government, but is not a "one size fits all" solution.

Even if we do not have a strategy, we need to restore the lost art of programming – making hard choices up front and committing the resources to make them work. It takes discipline in program and project management. Besides continuing the "back to basics" approach rooted in systems engineering practices, we need a highly-qualified workforce. On the latter point, we need to restore the ranks of the government's acquisition corps, which has experienced an exodus of senior officials with significant acquisition experience.

There are a set of specific program and project issues that strategy can address. One, the reconciliation of requirements with stakeholders and budgets. Two, more consistent acquisition planning. Three, government block buys to not incur breaks in production lines, which carry great consequences for smaller subcontractors and sometimes force them out of business. This leads to the erosion of the space industrial base, a critical issue and one that merits some type of cross-agency industrial base strategy. Four, USG export policies and laws that can make it extremely difficult to make international sales, while strengthening international competitors.

An additional set of issues to be considered in strategy include: identify and manage all risks associated with programs and projects and not just budgeting to cover risk; align expectations for programs and projects between contractors and their program managers, not just the requirements; open communications between the contractor and government that are coordinated up and down the ranks and accomplished with a common goal in mind; the proper level of government oversight, which is value-added and aimed at achieving real risk reduction; and better alignment of government and industry to be clear on expectations and outcomes.

Strategic Management and Capabilities

Spacepower, strategy and doctrine have their foundations in the capabilities created through R&D efforts related to innovative science and technology projects. One of the most important and difficult aspects of leveraging R&D capabilities into organizational and warfighting value is creating effective transitions, translations and transformations between engineers, scientists, strategists and warfighters. Effective processes for selecting and implementing the most promising and innovative technologies to create valuable space capabilities through advanced R&D projects are investigated.

One important theme to keep in mind as we consider the development of strategy is to build upon the current set of capabilities that exist within the parameters of cost and risk that are acceptable. Within the context of program and project management, strategic management approaches should inform space strategy. An essential part of this is to assess how capabilities and the associated development of technology drive management, which, in turn, helps to implement strategy.

One key function of strategic management is to optimize the use of scarce resources to achieve

organizational goals and outcomes. In strategic management, the task of organizational leaders is to assess and anticipate environmental threats as well as understand and develop organizational capabilities. Leadership then formulates and implements strategies that achieve the goals and objectives of the organization. These strategic formulations and implementation plans guide key decisions that span multiple organizational units over the years of program and project development.

Strategic management and its relationship to the development and implementation of innovative technology is an integral part of any discussion of a national space strategy. In essence, the call to optimize space assets for the national interest of the United States is a call for the strategic management of space related resources and capabilities. Therefore, elements from the field of strategic management, innovation and technology management are important in a discussion of processes supporting a national space strategy. Specifically, if a national space strategy is capabilities-based, it will remain focused on building and executing space capabilities that support national priorities, including space policy and doctrine.

Space Program Development and Strategic Management: Discussion

It is important to consider why space is strategically important for the United States and to define the strategic problems, objectives and solution areas that a national space strategy should address. For example, what are the national interests served by space, what are the benefits derived from U.S. leadership in space, what are the problems in the current state and direction of the U.S. space enterprise and what role can a national space strategy play in implementing the nation's policies and executing its programs and activities in space. Central to addressing these questions is to assess why a strategy is even needed in the first place.

Space activities have grown and matured to include a diverse set of programs and capabilities across civil, defense, intelligence and commercial sectors and significant foreign and international cooperative activities. However, the USG remains by far the largest actor in space and therefore has a major influence and role in shaping the future directions of space domestically and internationally. The current topic areas for the National Space Strategy Project include a comprehensive and appropriate range of interconnected issues and considerations –intellectual foundations, domestic and international political considerations, governmental factors, economics and commerce, and developing space systems, among others.

The central strategic issue for program and project management and space capabilities is on the role of the USG in stimulating, developing and using space capabilities in pursuit of national interests and in fostering international and private space efforts to achieve the broader potentials of space.[20] Strategy needs to address the ways the USG should use its space agencies, programs, investments, coordinating actions, regulatory and other tools to perform these roles.[21]

Space capability development presents unique technical, management, financial, organizational and industrial challenges. The processes of deciding what space capabilities the USG will develop and use

[20]There are a number of plausible government roles, including: "patient investor," "dominant consumer," "owner and operator," and "defender and protector."

[21]Given the growing reliance on "commercial solutions" for important government needs, such as communications, imagery and cargo and crew space transport, what conditions and advice would the aerospace industry have for government users of space?

involves complex processes and bureaucratic and political factors. Once the USG decides what it wants to pursue, the actual development, production and delivery of new capabilities is fraught with technical, industrial base, management, funding and oversight challenges.[22]

Space development and acquisition are critical enablers of spacepower and U.S. leadership in space. Today, there exist pervasive and systemic acquisition problems across all space sectors in executing programs, notably major delays, cost growth, program failures and mission capability gaps. Leadership in space rests on competency in deciding what capabilities the USG needs and developing and acquiring capabilities from the aerospace industry and commercial operators.

The issue of capability needs and capability driven strategy and policy are very important to consider. While DOD and others embrace the concept of "capability based" strategy and planning, requirements review and approval, concept and architecture analysis, program formulation, budgeting and acquisition processes are lengthy and burdened with impediments. This is particularly true for space capabilities that in many cases are imbedded in a larger mission and where the capability provider and users are not well aligned. It would be advisable for some discussion on what role space capabilities play in the broader DOD and Intelligence Community missions. Concepts of operations are a critical tool in defining what needs to be done and how to go about doing it.

Program and project development cycles and the challenges of incorporating new technologies are important. It is crucial to bridge the technical "art of the possible" to what is needed and affordable. This also raises the question of getting the right balance between "technology push" and "operational pull." The development of space-based capabilities are also linked to the "value of speed" and to the benefits of distributed and incremental solutions. Government space, in particular, suffers from elongated cycle times, large-scale developments, and very costly and vulnerable solutions, which collectively conspire against and preclude resilience, affordability, technology innovation and program stability.

[22]It would be worthwhile to identify the greatest impediments and issues in space engineering development, production and program management processes, and to assess what specific policies, strategies and initiatives the USG could adopt to improve its role as a customer and a promoter of the aerospace industry.

Space Industrial Base

How do economics and commerce influence strategy? What are the costs and benefits for evaluating political and technical approaches to address security, civil and commercial space challenges? Both opportunity cost and comparative advantage will drive political and strategic decisions in space. In this regard, the political economy of space is important to consider. Other issues of importance include the role of government in advancing space commerce and the role of economics as a driver for innovation and development in the space sectors. Space commerce is characterized by a multinational and global environment. What role does space play in the national and global economies? What is the nature of global space business and commerce, and how does this relate to strategic space advantages and wealth creation for the United States and other spacefaring states?

The key strategic question to address for space economics and commerce is to what degree will we enable or constrain the space industrial base that forms the basis for what we want to do in space? Will our space industrial base be one to remain dependent on USG contracts? Will a true market economy across all space sectors develop? The emergent strategy to date is for the USG to essentially serve as the space industrial base in terms of government contracting, rather than privatized commercial entities. With approximately $60 billion spent annually by the USG on military, intelligence, civil and commercial space, there is continued reliance on the USG.[23] Yet, can the commercial sector continue to rely on the USG for the long-term given flat to declining USG budgets over the mid-term future?

There are strengths to the space industrial base. The U.S. industrial base is very capable in the development of complex, technical and state-of the-art space systems with a high degree of operational autonomy. The $60 billion spent annually by the USG on space represents four times what the rest of the world's governments spend on space.[24] At the prime contractor level, there is consolidation to a number of large, diversified and strong companies. And, space and aerospace companies that are primarily government contractors have done well compared to other industrial sectors.

There are weaknesses as well to the space industrial base. Consolidation, while a strength in some areas, such as with large-scale systems integration work, may also be limiting competition. In an era of declining budgets, the United States may not be able to afford competition. The industrial base is weak on optimization in terms of resources allocated by the USG relative to the numbers of spacecraft developed and launched. R&D spending by the USG and industry is declining. This is compounded by dramatic declines in the aerospace workforce. From 1990 to the present, workforce numbers declined by more than 50 percent, to 650,000 total aerospace employment and 78,000 in the space area.[25] Management and technical performance on key, very large space systems is a problem within and across agencies. An issue in this regard is the high degree of duplication and overlap that exists across

[23]The USG allocates approximately $60 billion annually for space. See *The Space Report 2009* (Space Foundation, 2009). Military space spending and NASA constitute 75 percent of the USG space budgets. Additional monies are allocated for the space intelligence sector.

[24]Based on *The Space Report 2009*, international government space budgets worldwide for 2009, not including the U.S., total $16.5 billion.

[25]See Aerospace Industries Association, http://www.aia-aerospace.org (accessed March 2010). Approximately, 30 percent of the engineering and science workforce in the U.S. is eligible to retire. Only 16 percent of the aerospace workforce is composed of 25 to 34 year olds, and 60 percent of the workforce is 45 years and older.

agencies and the military, intelligence and civil space programs of the USG. For example, can we afford to have separate launch infrastructures for each of the different launch systems in existence today? Weaknesses are further compounded by inefficient procurement and acquisition systems. The supplier base is also much weaker as they cannot shift resources around as much to cope with disruptions in demand – they are largely dependent on the aerospace market to sell. This base, represented by 2nd and 3rd tier supplier networks, is producing at less than 50 percent of capacity.[26] At this production level, skills atrophy and the industrial base erodes.

Given these weaknesses, what are opportunities for fixing the problems? One opportunity lies with more of a consolidated effort to work against the duplication and overlap that exists. A restructuring of NASA's exploration activities would be a step in this direction. NASA is planning to invest billions of dollars in technology development, such as developing a new hydrocarbon main engines for space launch, which if coordinated with military space requirements could be beneficial to both. New procurement and acquisition models are also needed to provide other opportunities, such as buying services and capabilities in large batches from government contractors and the commercial sector. One other opportunity deals with making use of secondary payload capability on space launches for a few million dollars in marginal cost.

The USG does need a coherent and explicit space industrial base strategy to maintain the U.S. lead in space worldwide and to mitigate the potential for a "perfect storm" of weak human capital, weak supplier base and declines in budget, which seriously erode the space industrial base and the lead of the United States. On policy, the USG should not try to support the commercial space industry directly, as the sector is too small and there is currently too little return-on-investment to make it worthwhile. Rather, the focus should be on specific areas of concern with the industrial base, primarily procurement and acquisition reform to enable block buys, and consolidation of requirements and effort across agencies and programs.

Space Industrial Base: Discussion

Government strategy is difficult and there are many goals and objectives to account for with respect to economics and commerce. Strategy should account for economic conditions today. To complicate matters, the issue of national security trumps all other issues. Hence, economics and commerce are subject to national security concerns If economics is not the dominant consideration for government, how to you implement it as a secondary concern?

Do we include a strategy for commercial space in an overall strategy? Probably not, if we are only considering it at the top-level. But in implementation, we need a commercial component to a national space strategy. Commercial space activities serve national priorities and play a role in foreign policy, particularly with regard to soft power projection. Economics provides a value proposition to security and civil space programs, and a framework for assessing opportunity costs for space expenditures.

There are a number of factors to take into account in relation to strategy and space economics and commerce. The space industrial sector is not truly a free market, rather it is oligopolistic.[27] Aerospace involves more areas than just space technology. Tax incentives, acquisitions and regulations are other

[26]The 50 percent production rate was determined by surveys conducted by prime contractors in regard to their supplier base.
[27]A market condition in which sellers are so few that the actions of any one of them will materially affect price and have a measurable impact on competitors.

areas to consider. In the area of regulations for example, the USG hinders commercial space with current export controls laws and approaches to intellectual property rights.

Earth Observations

The wealth of nations is acknowledged to reside in part with their assets in the form of natural resources, including both the physical endowments of these resources and their management. The vantage point of space as a means of observing domestic and international natural resources represents an increasingly important source of information with strategic implications. In what ways should the United States' investment of tens of billions of dollars in Earth observations figure in a national space strategy? How can we improve understanding of the strategic importance of Earth observations? In light of the strategic value of information, how best do we organize domestic agencies to collect and use observations, and more specifically, how best might we exploit USG ownership and use of Earth observations for domestic goals? If we give primacy to our domestic goals, what are the implications for international cooperation in financing space assets and sharing data? Should we more strategically manage our cooperative efforts?

There is debate on the role of Earth observations in national space strategy – is it complementary or a distraction to the development of strategy? On one hand, Earth observations provide critical information, which affects national and economic security. As an example, climate is a global good and the focus on climate change is an issue of importance for national security based on the U.S. National Intelligence Assessment.[28] On the other hand, Earth observations can be a distraction from strategy. Scientists, who set goals for Earth observation programs and projects, put forward interests that are not centered on national security, but on scientific advancement.[29] In practice, the mutual benefit from defense and civil Earth observations is ad-hoc, not strategic, as is dual-use technology for Earth observations.

The management of Earth observations data as strategic information, i.e., how to collect, analyze and disseminate data, and whether and how much to cooperate internationally, is an associated issue that further links this area to national and economic security. There are a number of questions that strategy needs to address in this regard.

- Whose information authoritatively "rules" when Earth observations data exhibit discrepancies?
- Whose job is it to "speak" for the value of Earth observations in military and economic security?
- Who pays for the information as Earth observations assets are expensive?
- Is international cooperation desirable or even workable in Earth observations if the information and data is considered to be of strategic value?

On the issue of who is authoritative, it is important to note possible areas of discrepancies. There are discrepancies in data from U.S. Earth observation assets compared those of other states. Discrepancies exist in assessments as well, which can be an important economic issue, such as with the example of

[28] See National Intelligence Council, http://www.dni.gov/nic/special_climate2030.html (accessed March 2010).

[29] See *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007). NASA relies on the science community to identify and prioritize leading-edge scientific questions and the observations required to answer them. One principal means by which NASA's Science Mission Directorate engages the science community in this task is through the National Research Council. The Council conducts studies that provide science community consensus on key questions posed by NASA and other USG agencies. The broadest of these studies in NASA's areas of research are decadal surveys.

carbon offsets. Also, there are problems of ground-truthing data, where states tend to self-report.
On the matter of value and who pays, it is important to assess the social and economic benefits of Erath observations, such as in areas of natural disaster mitigation, global change and climate change.[30] Additionally, Earth observation systems are expensive and there is the problem of charging for information about natural resources, when data policy and intended use treats the information as a public good.[31]

In relation to international cooperation, there are a number of issues that can work against cooperation. As a scientific discipline, Earth science, there is pressure to publish first and to allow for the information that is gathered to be reserved for a period of time for the use and assessment by the principal scientist or investigator. There are key differences between science collaboration, which is more common, and sharing of information about valued natural resources that are under sovereign control of states. Data access can also be limited as a result of fees.

Concomitantly, there is great deal of cooperation worldwide with Earth observations. There is, for example, the Group on Earth Observation as an outcome of the G8. Related to this cooperation is the concept of a Global Earth Observation System of Systems. And, Earth observations are important to the work of the Intergovernmental Panel on Climate Change within the United Nations Framework Convention on Climate Change.

Earth Observations: Discussion

The approach to Earth observations in the United States is not strategic. Earth observations are driven by scientific interests and by the systems and technologies that are developed. There is a gap in the U.S. case with Earth observations between NASA that deals with experimental systems developed with scientific interests and NOAA, which deals with operational systems and the applications of Earth science There exist tensions in the development process and there is also tension over data – data may be of strategic value as to not share it, but this is at odds with the goals and policies of Earth observation data use, e.g., using it to improve lives and combat climate change.

To add, interagency cooperation in the United States on Earth observations has not worked well. The National Polar-orbiting Operational Environmental Satellite System (NPOESS) and systems like it are not encouraging of interagency cooperation, and there tends to be institutional inertia against cooperating on Earth observations. One complicating issue to interagency cooperation is military involvement. In fact, combining civil and military requirements helped bring down cooperation on NPOESS among NASA, NOAA and the U.S. Air Force.[32] In this instance, dissemination of data was a significant issue.

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[30]The U.S. has done a poor job at estimating how much of a difference space-based Earth observations make. The measuring stick for value is usually the number of scientific publications and scientific achievement. Nevertheless, see, for example: Ray A. Williamson, Henry R. Hertzfeld and Joseph Cordes, *The Socio-Economic Value of Improved Weather and Climate Information*, Space Policy Institute, George Washington University, December 2002, http://www.gwu.edu/~spi/reports.cfm (accessed March 2010); and Ray A. Williamson, Henry R. Hertzfeld, Joseph Cordes and John Logsdon, *The Socioeconomic Benefits of Earth Science and Applications Research: Reducing the Risks and Costs of Natural Disasters in the United States*, A Report Prepared for NASA, July 2001, Space Policy Institute, George Washington University, December 2002, http://www.gwu.edu/~spi/reports.cfm (accessed March 2010).

[31]In general, natural resources are public goods, although they can be private goods – they have economic value and they are privately owned in some cases. Also, climate is global public good and observing climate is also public as would be the assets used to do so.

[32]As of March 2010, NPOESS was formally cancelled by the USG.

How do you structure the Earth observations enterprise to fit into a national space strategy? If we begin to think of Earth observations as strategic, we will need to take a long-term strategic view to set the agenda and priorities, and to make sure bureaucracies and agencies implement from that agenda.[33] This will require changes in how we approach Earth observations as to funding, organization, implementation and use.

[33]For a relevant long-term strategic view on Earth observations, see *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007).

Space Assurance

National Security Space is dependent on the use of space assets. At the same time, space assets are vulnerable to interference and disruption, either due to natural hazards of the space environment or due to deliberate efforts like electronic interference and kinetic anti-satellite weapons. Given these vulnerabilities, how can a strategy help to address the protection of space assets and deter others from interfering with space assets? What are the political, diplomatic, economic and technical means to achieve a secure space domain and freedom of action in that domain?

The United States is more dependent on space than any other state, not only for national security, but with its private sector as well. National security space capabilities – precision navigation and timing, battlefield and battlespace characterization, missile warning and defense, weather, communications, intelligence, surveillance and reconnaissance – enable the United States and its allies to efficiently and effectively reach out, shape, support and control events in any part of the globe. Space capabilities are important enablers for successful 21st century global economies, information transfer, diplomatic communication and collaboration.

Recognizing the importance of protecting satellites as strategic assets, the United States has effectively employed a comprehensive strategy to preserve access to their capabilities since the earliest stages of the space age. Under this strategy, space systems must be protected so they can operate for the short-term and long-term. This involves more than just dissuading, deterring, defending against and defeating adversaries seeking to neutralize, disable or destroy space assets. The global space community must also be encouraged to operate in a manner conducive to safe space operations by all members. Non-adversary problems, such as orbital debris, spectrum management, safe spacelift and de-orbit operations must also be addressed. The U.S. industrial base must be vibrant and robust, and allowed to flex its muscles, in order to ensure it can deliver capabilities when needed.

Emerging threats posed by hostile states, non-state actors and the space environment serve as a catalyst for reappraisal of the political, diplomatic, economic and technical means the United States must implement to protect against and defeat threats to space assets. Yet, U.S. space systems have for the most part not evolved to defend themselves against these different threats. The United States is essentially left with a legacy system. In order to respond to the threats, the foundation for a space strategy should be rooted on first deterring others from interfering with space assets, and if that fails, protecting space assets from threats.

The U.S. military advances a definition of deterrence that defines vital national interests and discusses dissuasion or coercion against potential threats to these interests. To achieve deterrence, you must alter adversary behavior. There are four ways to accomplish this.

1. Deterrence by denial, usually by eliminating benefits the attacker can derive from specific courses of action, such as with counterspace, survival of systems and defeat of the attack before it is launched.
2. Deterrence by cost-imposition, such as a “mutual assured destruction” concept, or more reasonably other attacks using military power or economic, diplomatic or other means.
3. Deterrence by inducing adversary actions, e.g., shifting postures to alter the form of a challenge or attack so that it does not damage vital interests like space assets.
4. Deterrence by entanglement dealing with integrating disparate commercial, allied and even

adversary interests in support of one's space system, which could significantly increase the geopolitical costs of eliminating, neutralizing or degrading them, by involving other stakeholders in any dispute or conflict.

Because deterrence may fail in the present or future, and has failed in the past, the United States needs other ways of protecting its space assets. Protection can be passive or active. Passive protection includes maneuvering capability, redundancy, layered systems and ORS. Active protection entails military strikes on ground stations, launch pads and other key nodes that support access to space. A space-based active protection approach is not advisable given that it will cause more harm in the form of orbital debris effects than gains in protecting space assets.[34]

A combined deterrence and protection strategy is incomplete for several reasons. One, going first with attack is always plausible in times of conflict as it can yield advantages. This implies deterrence failure. Two, by calling space systems vital, the U.S. issues a deterrent threat, yet highlights the value of space assets as a target. Three, there are some actors that cannot be deterred. Four, actors can be poor stewards of space and engage in reckless or irresponsible actions on orbit. Lastly, there are space environmental threats, such as space debris and space weather, which clearly cannot be deterred.

Given these reasons, *space assurance*, not deterrence and protection, is the real strategic goal. A space assurance strategy is a strategy to assure the U.S. and its allies have access to space capabilities. Assurance includes deterrence and protection and it is the overarching strategy. In addition to aspects of deterrence and protection, global engagement, space situational awareness (SSA) and responsive infrastructure, like ORS, are essential elements of moving toward a space assurance strategy. By entering into diplomatic agreements, we can shape the actions of others to achieve space assurance;[35] SSA helps prevent the creation of space debris, mitigates orbital conjunctions and provides for overall space traffic management; and responsive infrastructure implies that the industrial base can respond to threats on orbit, change the way that systems are built as to cost and schedule, make systems less vulnerable and be able to improvise against threats, including the capability to "fight through attacks" on space systems.

Space Assurance: Discussion

The U.S. needs to support the assertion that the potential for conflict among all actors is increasing even though conflict in space with a specific adversary is not predestined. There are several issues in this regard. What are the dynamics driving the threat environment, e.g., technology proliferation and rogue actors? Is the potential for space conflict a long-term prospect – are the threats going to continue to get worse or not?

With respect to specific threats, potential adversaries that cannot be deterred, like rogue states and irresponsible actors, need to be considered. Strengthening rules for space behavior is useful, however, this alone does not help address states and other actors who decide not to follow existing rules. Given the range of different threats that exist, i.e., threats will vary with the type of actor, it is helpful to disaggregate the threats and how to respond. For example, the things that smaller states might do to U.S. satellites are much different from the things that a capable, spacefaring actor might do.

[34]Deterrence by cost-imposition in space will likely fail due to orbital debris effects and the threat of that to space systems.
[35]Global engagement can include as well collective, shared approaches to security.

There is much discussion here on how the United States might be attacked, but much less about who might attack us and very little about why they might attack us. Motivations play a role to deter an attack, especially on how difficult it will be to do so. Similarly, it is important to not only analyze what could happen to space assets, but also to assess which types of threats and actors are more or less likely to emerge. If you are a decision-maker, you are faced with trade-offs.[36] Thus, you want to be able to prioritize and focus on the most likely threats so that you know where to invest and what steps you need to take.[37] In a national space strategy, guidance on what is and is not acceptable when responding to attacks on U.S. satellites is helpful. The context of an attack is also important,[38] e.g., is it in times of war or conflict or is it an isolated incident. Some of the more challenging issues exist when a satellite attack is in the context of a war. In this case, deterrence by punishment does not apply as many targets are attacked in the normal course of war.

[36]Steps to counter threats will be expensive, so you probably will not be able to do everything.

[37]An associated issue is one of command and control and how would it be executed. Deciding on who makes the decision about response is a top-level matter. The U.S. President is the de facto choice, but everyone might not agree as response is more of a tactical choice, where the President gets into choosing targets. The assumption that the President is the best one to make the decision of response is not a given.

[38]A near-peer to the U.S. is not likely to strike space assets as a one-off event – more likely, during a broader conflict. The new space players and rogue states are probably more likely to be challengers, but they can be engaged about exercising good stewardship of space.

Space Governance

How can cooperation achieve international and multinational progress towards common strategic objectives? Space strategy development can provide a framework for cooperative space development since space is a shared global commons. In what ways is space strategy development tied to international governance of space? What role do codes of conduct, rules of the road and cooperative and shared space situational awareness play to advance sustainable and peaceful uses of space?

The basic features of the space environment create high levels of interdependence, and thus, strong incentives for both cooperation and competition and major spill-over effects from one issue domain to another. As such, we need to think about national space strategy not as independent choice on how best to connect ways and means to achieve ends, but as interdependent choice, i.e., one player's ability to accomplish their ends depends not only on the wisdom of their own choices, but also on other's choices. In other words, in every aspect of this space strategy project, we should give serious thought not only to what the United States wants to accomplish, but also to what other states and non-state actors want, and how what we say and do about space affects other player's choices and everybody's ability to benefit from space over the long-term.

Important questions for thinking about strategy and space governance and international cooperation include: how can cooperation achieve international and multinational progress towards common strategic objectives; and what are the crosscutting implications for different aspects of U.S. national space strategy? There are very different ways of answering these questions depending on how we define "common strategic objectives."

From a cooperative perspective, space users share a set of basic strategic goals, which were put forward in the National Space Strategy Project: to secure the space domain for everyone's peaceful use; to protect legitimate space assets from various types of threats; and to derive maximum collective value from space assets for security, economic, civil and environmental ends. These goals are embodied in the 1967 Outer Space Treaty. Most commercial, civilian and environmental space users still think about space this way, as do many people who think about the contributions of space to cooperative security.

From a sovereign perspective, there is the fact that each state can define its own strategic objectives in space and try to maximize its own strategic gains in space relative to potential rivals. The United States can cooperate closely in space with its allies, but should only cooperate with potential adversaries when the United States gains more than the potential adversary does. Even cooperation that disproportionately benefits the United States may be dangerous if the disadvantaged player can use even a small improvement in their space capabilities in an asymmetrical attack. This conception has been implicit in much of recent U.S. space policy, most obviously in military documents and export controls.[39] The risk with this perspective is that agreement on even minimal types of space cooperation or collective approaches are unlikely, which in turn, can damage U.S. ability to use space for security, economic, civil and environmental ends.

A key issue concerns the best way to conceptualize when, why and how a U.S. national space strategy

[39]The 2006 U.S. National Space Policy was framed much more explicitly than before in terms of exploiting space for national military, economic and other unilateral advantages rather than for mutual gains.

should include international cooperation. The links between space cooperation and the concepts of "space as a global commons"[40] and enhancing shared strategic objectives are important in this regard. Management of the global commons highlights the need for some minimal forms of cooperation. But it focuses on such a limited set of common interests and weak governance mechanisms that currently exists in space, that such management does not provide adequate incentives for entities to forgo short-term individual gains in return for long-term collective benefits. The norm today of voluntary actions or mutual self-restraint to protect the space environment will be hard to sustain in the context of competitive security relationships among major spacefaring states and the increasing number and variety of actors. On the other hand, space cooperation to enhance shared strategic objectives is a way to maximize the commercial, civilian and environmental benefits that can be gained from space. It would require major revision of the military side of space strategy, but such revision can enhance national security for the United States.

Space as a global commons is characterized by scarce resources, e.g., geosynchronous orbital slots and radiofrequency spectrum, congestion concerns in certain high value and high traffic orbital regimes and environmental degradation problems, such as space debris effects. Even though these are relatively small problems at the moment, they receive much attention when the subject is international cooperation to enhance space security because all space users are affected by these problems and all share a common interest in managing them efficiently.

Of the potential solutions, there is no serious discussion about trying to limit the number of spacefaring states. Nor is it reasonable to think that one state could seize control of all of space or that multiple countries could effectively exert sovereign control over enough of space to meet their own needs through some type of private property solution. Technology can help make more efficient use of scarce space resources, minimize the amount of space debris created during launches and at the end of satellite lifetimes, and avoid collisions between debris and active space objects, but these technologies are of limited value unless everybody accepts the extra costs of using them even when it is not in their short-term self-interest to do so.

This implies that some form of space governance is important to manage space as a global commons. The most plausible approach is one based on "governance without government" – different kinds of arrangements for organizing states and other international actors so that they can solve shared problems and achieve collective goals in the absence of an overarching political authority. What are the implications for national space strategy, if the main reason for space cooperation is to preserve the space environment as a global commons?

First, the need for greater cooperation is growing, but not yet urgent because the number of space users and space objects is still relatively small compared to the size of the space environment and the barriers to entry. Second, key spacefaring players will prefer voluntary coordinating mechanisms over mandatory

[40]Describing something as a "global commons" is shorthand for talking about collective choice problems where multiple players share a finite common resource and the benefits of using that resource accrue directly to the actual user, while the costs are spread out among all actual and potential users. Possible ways to solve this problem to sustainably manage the common resource include: restricting access so total usage cannot exceed carrying capacity of the resource; privatizing the resource, such as dividing it into exclusive use zones on the basis of power (players with the most military capability or money get more resource) or some more equitable principle; developing technology to use the resource more efficiently and sustainably; encouraging more sustainable behavior through market-based incentives, e.g., fee for use or polluter pays; informal coordinating mechanisms, e.g., social norms, codes of conduct and self-enforcing rules of the road; and mandatory regulation of access, capabilities or behavior.

rules and strong mechanisms for ensuring compliance because they care more about keeping the costs of cooperation low for themselves than they do about getting high rates of compliance by everybody.[41] Third, rules of the road[42] and codes of conduct can frame a context for what it means to be a "responsible spacefaring nation," but avoids most controversial issues and the measures are voluntary with no compliance mechanisms besides social and diplomatic pressures.[43]

A key part of the equation in space governance is how improved SSA can help manage global commons problems in space. There are several ways in which management of the problems can be improved upon with cooperative SSA: more accurate information can enable better decisions about how to use space most efficiently; knowing more about natural hazards and debris in space can minimize the risk of false alarms, such as distinguishing between a natural hazard and an intentional attack or threat from an adversary; and greater transparency will provide more information about who is following behavioral rules and who is not. One attractive feature of the global commons concept is that it highlights shared space environmental interests, which is fostered with shared, cooperative SSA, while avoiding or obscuring contentious space security debates.

Yet for policy-makers in the United States and elsewhere who care about space, security concerns will trump environmental considerations, especially if the perceived security benefits are immediate and the environmental consequences are more long-term. If you want more cooperation to protect the space environment, then you either have to make all the incentives – military, economic and environmental – point towards the same behavioral choices or you need stronger cooperative institutions, i.e., more clear-cut, legally-binding rules and more developed verification, compliance management and enforcement mechanisms, so that states and other space entities are less likely to give in to the temptation to do something damaging to the space environment.

Given the priority placed on security concerns, the way to get cooperation more quickly than can be accomplished with the global commons approach is to start from the premise that current and future space users share the basic strategic goals that were posited for the National Space Strategy project. It is notoriously hard to figure out the goals or objectives of other states. But if we want other states to believe that U.S. strategic goals and objectives in space are not in conflict with their interests, and that therefore they should be comfortable with a world in which the United States has much greater space

[41]Sustainable management of the global commons through norms that promote reciprocal self-restraint requires each player to sacrifice some freedom of action or pay some extra costs in the short-term in the expectation that all other players will do likewise and everybody will be better off over time than if they had all behaved selfishly. It is much easier to sustain cooperation on this basis when those who are using the commons are members of a stable community who expect to continue cooperating over an extended period of time, whose livelihood depends on the sustainability of their shared resource and who care deeply not only about their own economic interests, but also about their social relationships with others using the common resource.

[42]"Rules of the road" is a phrase that is commonly used in discussions of space governance, but it means widely different things to different people. It is most commonly used as synonym for voluntary space behavioral guidelines, but there is nothing voluntary about regulations. Some cooperation theorists use "rules of the road" to refer to self-enforcing coordinating mechanisms where the direct risks of breaking the behavioral norm outweigh any minor benefits that might be gained. There is nothing comparable in space, e.g., using nuclear weapons in space could cause direct and immediate damage to your own satellites, but the countries with the most satellites have the least reason to do this, and the countries that might be most tempted have few if any satellites to be damaged. Other actions that generate space debris could come back to harm the originator, but the punishment is longer term and highly probabilistic. Anyone who talks about rules of the road with verification, compliance and enforcement mechanisms is using the phrase as a euphemism for a legally binding international agreement. As the phrase obscures more than it clarifies, it is not analytically useful.

[43]If the rules are voluntary, options for responding to non-compliance are limited to expressing disapproval, engaging in reciprocal rule-breaking and taking some type of compensatory unilateral action.

capabilities than they do, then we should pursue policies based on this broad formulation of shared strategic interests and see how other countries react instead of assuming the worst and then feeling vindicated when competition or conflict rather than cooperation takes place. In this way, states and non-state actors would have much stronger and more immediate reasons to cooperate in space than just to protect the space environment from degradation over time. They would also have less reason to fear that others would defect from cooperation, i.e., fail to reciprocate restraint and honor agreements or use gains from cooperation now for competitive advantage in the future.

Incentives for this kind of space cooperation, one based on a set of shred strategic goals and objectives, are stronger if the overall intent of space strategy is not limited to deriving maximum value from space assets for security, economic, civil and environmental ends, but includes ways in which the U.S. approach to space cooperation can serve fundamental strategic goals and objectives. A national space strategy should explain why the central problem for U.S. is *strategic assurance*, and how changes to space policy can play an important role in providing and receiving credible strategic assurance from other spacefaring states.

Space Governance: Discussion

The approaches to space governance encompass: a rules and law approach based on the framework of existing space treaties; a security-based approach; and a global commons approach. For the rules and law approach, there are many benefits for space governance. Adherence to the Outer Space Treaty is foundational and we should support broader adherence to it. At the same time, there are also benefits with the security-based approach. For example, allies may be comforted if we take a strong position on responsible space behavior and cooperate on a bilateral basis for space security. Since security considerations trump environmental ones, a bilateral approach among allies for space governance is pragmatic.

The global commons approach may obscure matters more than help them as much of that approach is based on voluntary measures and mutual self-restraint, which lacks credible reassurance. Yet if we are to effectively manage and govern space, the mindset of a global commons is essential. This understanding is growing and it may grow among policy-makers in the United States as well.[44] A key part of the global commons approach is to increase transparency. This will be difficult, but is worth effort. Transparency rests on shared SSA not just in terms of data, but also in terms of attribution.

In many ways, the rules and law approach and global commons approach are complimentary as they both have the benefit of legal status. We can draw precedents from other treaties and commons, like the Antarctic.[45] These two approaches are necessary for space governance and they rest on the fact that the use of space is marked by interdependence and that the rules and laws of the Outer Space Treaty regime are based on the concepts of reciprocity and equity.[46]

[44]To date, the Obama Administration has taken the view of space as a global commons.

[45]See the Antarctic Treaty System, http://www.ats.aq/index_e.htm (accessed March 2010). In general, global commons include, in addition to outer space and the Antarctic, the electromagnetic spectrum, the high seas per the Law of the Seas, and the global environment and climate.

[46]Reciprocity is based on the notion that if I want to make sure that I can do *x*, I have to make sure you can do the same. It forces an interdependent relationship and it forces an actor to think about their own self-interest, i.e., before saying no to something, they must think about whether they might want or need it in the long-term. The legal concept of equity is intended to work when the law leads to unequal results as was discussed with the implications of the use of space as a global commons. It often involves talking about negative responsibilities, like avoiding harm to the space environment. States and actors often

International Space Strategies

The session on international strategies focused on the development of space strategies and issues of space policy in Russia, Europe, Israel, Japan, India and China.

Russia

The Russian Federation does not have a written document establishing a national space strategy, but there exists a long-term national strategy to guide the development of space programs and projects. Often, the programs and projects of the Russian Federal Space Program are equated with space strategy. In 2006, the Federal Space Program put forward a ten year plan, 2006-2015, which covers specific programs, timelines, funding and implementation. The strategic intent of the space program is to increase standard of living, foster economic growth and provide for national security.

The ten year space program strategy is modified as needed to meet national priorities and budgetary parameters. In Russia, space projects are prioritized in two key documents – space policy priorities and military priorities. Close to two-thirds of all Russian space projects have national security priorities and implications, hence the reason for dual funding of programs and projects from the civil Russian Federal Space Agency, Roscosmos, and the Ministry of Defense. In addition to military space, space launch capabilities are prioritized in Russia, e.g., Russian space launchers capture 40 percent of global total. Other areas of concern lag far behind and many projects are delayed or indefinitely postponed due to funding shortages. This includes, among other areas, commercial satellite services, Earth observations, meteorological satellites and deep space robotic observation.

Europe

Similar to Russia, Europe has no explicit space strategy. But is the lack of a strategy in Europe a problem or an opportunity? There exist policies and programs at the European level with both the European Union and the European Space Agency. In the case of the European Union, for example, the Lisbon Treaty states that "the Union shall draw up a European Space Policy" and that the implementation of this policy "may take the form of a European space program."[47] Yet implementation is complicated by the fact that there exist national-level programs in Europe.[48]

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have more comfort with these kinds of responsibilities.

[47]The recent entry (December 2009) into force of the Treaty on the Functioning of the European Union, known as the Lisbon Treaty, enshrines space policy as "shared policy." It gives a clear mandate to the European Commission to exercise its right of reinforcing the momentum of the European Space Policy embodied in Space Council resolutions and endorsed by the European Parliament. The Lisbon Treaty, in relation to space policy, states: "1. To promote scientific and technical progress, industrial competitiveness and the implementation of its policies, the Union shall draw up a European space policy. To this end, it may promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space. 2. To contribute to attaining the objectives referred to in paragraph 1, European laws or framework laws shall establish the necessary measures, which may take the form of a European space program. 3. The Union shall establish any appropriate relations with the European Space Agency."

[48]The Lisbon Treaty provides that: "In the areas of research, technological development and space, the Union shall have competence to carry out activities, in particular to define and implement programs; however, the exercise of that competence shall not result in Member States being prevented from exercising theirs." In other words, individual member states retain sovereign discretion to draft and implement their own national policies and legislation in the area of space.

A particular area of focus for Europe deals with space and security. In this area, however, there is an absence of policy and strategy. Despite this, a great deal of progress in space security programs exists at the European level, including programs in cooperation with the United States, such as with SSA.

Israel

The Israeli space program was established in 1981 because of national security needs and the desire to be self-sufficient in high-technology areas.[49] Although Israel does not have an explicit national space strategy, Israel's space capabilities have reflected its general emphasis on advanced technology in the economy and on the importance of maintaining a qualitative edge in the conflict with states hostile to its interests. Israel has come to realize that its economic growth, national security and international credibility are inextricably linked with space.

The Israeli approach to space is pragmatic and focused on niche technologies that satisfy national security needs, such as remote sensing and Earth observation, communications, small satellites and ORS technologies. Israel has developed a space industrial base characterized by a skilled workforce, technological capacity and advanced manufacturing capabilities.

Japan

Japanese space policy and strategy are framed by new approaches to space diplomacy and by the reform of space organizations. In regard to space diplomacy, the new Japanese Basic Law for Space Activities was established in 2008. According to the Basic Law, a new Minister and a new Strategic Headquarters were established for space activities. In 2009, the Strategic Headquarters announced the new Japanese Basic Plan for Space Activities. In the past, Japanese space activities were not been linked with diplomatic policies due to lack of coordination. The Basic Plan stipulates that Japan should advance both "space activities for diplomacy" and "diplomacy for space activities."

Space activities for diplomacy imply the use of space to accomplish diplomatic purposes. For this end, to illustrate, Japan should take better advantage of the International Space Station program, the Asia-Pacific Disaster Management Support System through the Asia-Pacific Regional Space Agency Forum and the Asia-Pacific Space Cooperation Organization.[50] In the area of diplomacy for space activities, Japan needs to better make use of foreign assistance through space cooperation to help developing states. By offering assistances and services through its advanced space science and technology capabilities, Japan can promote human security in developing countries. Japan should also be more active in the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) and in the United Nations Conference on Disarmament to promote diplomacy for space activities.

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[49]The failure of Israel's strategic posture in the early 1970s that led to the 1973 Yom Kippur war led Israeli officials to conclude that an indigenous means of acquiring intelligence data through reconnaissance satellite was essential for national security. This conclusion was reinforced by the lack of satellite intelligence available to Israel from the United States during the Yom Kippur war. As a result, the development of an Israeli space program began in 1981. Since then, Israel developed a number of indigenous capabilities that entailed most significantly a reconnaissance satellite program, satellite based telecommunications and an indigenous space launch vehicle. From an Israeli perspective today, the U.S. needs to adopt a more liberal approach to international space cooperation with Israel in the area of military space.

[50]The Asia-Pacific Regional Space Agency Forum, under the initiative of Japan, is an agency-level forum to promote regional space utilization. The Asia-Pacific Space Cooperation Organization, under the initiative of China, is an intergovernmental organization to promote collaborative space programs. Although the two organizations are different, there is the need for Japan to engage China about regional cooperative space efforts.

India

Even though India established a national space program and the Indian Space Research Organization in 1969, there is no space policy, doctrine, strategy or white paper on the subject. This leads India to put forward programs with specific short-term goals and motivations.

Nevertheless, there are a number of strategic mandates that underlie India's space efforts. These mandates include indigenous development in a number of areas: space technology in the service of social development and more generally humanity; satellites for military use consistent with international law; protection of interests and assets in outer space; space technology development in telecommunications, Earth observation, launch capability, and science and exploration; and niche technologies to be competitive in international space commerce.[51]

China

China has not declared a space strategy, however, China's policy proclamations, state regulations and government white papers have made clear strategic intent. The Chinese government has set up various agencies to administer different aspects of its space endeavor – civil, military and commerce.[52] China has developed a capable space industrial base in terms of R&D, manufacturing and space launch.

The Chinese government has made clear the purposes of space development. These purposes are comprehensive in addressing both national and international interests.

1. To explore space to expand the understanding of the Earth and universe.
2. To peacefully use space to promote human civilization and social progress, and to benefit humankind.
3. To meet the needs of economic construction, scientific and technological advancement, and national security and social progress, while enhancing national science quality, defending state interests and advancing national strength.

International Space Strategies: Discussion

Although other spacefaring powers do not have official national space strategies, they do make decisions on priorities and trade-offs that the USG might be able to draw some lessons from.

1. In the case of Russia, what is their interest in the United Nations Conference on Disarmament related to the Prevention of an Armed Race in Outer Space (PAROS)? Further, how will the cancellation of Project Constellation in the United States relate to Russia's drive to exploit human spaceflight and commercial opportunities?
2. For Europe, the tensions between the North Atlantic Treaty Organization's use of space for military purposes, European Union Space Policy and Galileo posit interesting questions and possibly answers on how a large number of stakeholders in Europe can cooperate.

[51]Some Indian space projects are now shifting to the long-term in planning and development. Examples include: cryogenic engines and solid propellant rocket motor, both of which have long-term applications in deep space exploration; regional navigation system, mainly for use within India; remote sensing of the Moon; and plans for human spaceflight, including reusable launch vehicles and space tourism.

[52]For example, important organizations and agencies for space in China, include, among others: China Aerospace Corporation; China Great Wall Industry Corporation; China National Space Administration; China Satellite Launch and Control General; Chinese Academy of Launch Vehicle Technology; Chinese Academy of Sciences; Chinese Society of Astronautics; Commission for Science, Technology, and Industry for National Defense; National Ministry of Defense; and the People's Liberation Army. In China, there are strong interrelationships among civil, military and commercial space.

3. With Israel, the work on small satellites is interesting as to the development of certain technological niches, such as responsive space capabilities. In addition, how reactive will Israel likely be vis-à-vis space and missile related developments in Iran?[53]
4. In the case of Japan, how will issues play out between an emphasis on space for diplomatic purposes and the emerging use of space for military and national security purposes?
5. For India, there is a great deal of focus on social development aspects and peaceful uses of their space program. How is this focus influenced by more recent interests to develop military uses of space, including anti-satellite weapons?
6. With China, there seems to be a "Janus-faced" strategy of support for PAROS, on one hand, and anti-satellite weapons testing and capabilities, on the other hand. How will this issue be resolved?[54]

The issue of norms should be considered in the context of international space strategies and issues. In particular, to what extent do spacefaring powers take into account their perceptions about international norms and are existing practices seen as acceptable and worth following? By and large, norms are only established if the actors perceive them to be in their own interests.[55] Most emerging and small to medium spacefaring powers will be inclined to leave decisions on norms to the major space powers. Yet the physics of space implies that all states have an impact. On the issue of norms and governance, there is a growing role for others, i.e., non-major space powers. UNCOPUOS is one example of this change, where emerging space powers are involved.[56]

There are a number of important questions to consider concerning the implications of international space strategies.

- What will be the extent of U.S. dependency on Russia for human access to space during the gap in this capability in the United States?
- Will India align with Russia, or even China, in preference to the United States?
- What are the next steps for China, including options for human lunar capabilities and being a responsible stakeholder in space?
- How will changes in Japan's Space Basic Law translate into actual dual-use capabilities?
- Will Europe create a human spaceflight capability? Will it create a military space capability outside NATO?
- How and in what ways should international space commerce consider orbital debris, financing, insurance, property rights and continuing impacts of export controls?
- Does international cooperation in space offer lessons for other major efforts, such as climate change and international development?
- Will space exploration develop in a more integrated or fragmented manner compared to today? Will cooperation be preferred among "common value" space powers, new entrants and/or all actors?

[53]Iran is concentrating on the design of launch vehicles and satellite payloads. Iran plans to send exploratory rockets, Kavoshgar (Explorer), into space paving the way for operational spaceflight capability. Iran declared in 2005 that in order to reach its goal of ranking among the top spacefaring nations, the government would allocate significant resources over the next five years to the space program. In 2010, a Kavoshgar-3 rocket was launched with living organisms onboard and returned to Earth. Iran also launched a satellite on a domestically built *Safir* rocket in 2009.

[54]In 2007, China successfully tested an anti-satellite weapon. The interest to develop this capability could be a hedging strategy for China in relation to other space powers, including the United States.

[55]In this regard, the European Union is trying to show more self-confidence and assertiveness in international diplomacy based around an identity that is manifest in a *Code of Conduct for outer space activities* put forward in 2008 by the Council of the European Union.

[56]Emerging space powers play a role in UNCOPUOS subcommittees on legal and technical issues. In this way, these powers can advance ideas about how space-related issues are handled.

CONCLUDING REMARKS

There are a broad set of challenges for any USG initiative. These challenges entail: a dramatic rise in national debt and transfer payments; a weak national economy and global economic turmoil; an aging population; rising health care costs; on-going national defense and military costs; infrastructure recapitalization; and the rise of non-state threats. There is as well a set of specific challenges inherent in the development of space strategy.

1. For civil space, answering scientific questions as a global community; promulgating values of space behavior; advancing climate monitoring, space science and planetary protection; and exploiting opportunities for technology innovation and education.
2. With national security space, there are multiple and uncertain futures and threats; non-state actors to account for; strategic goals and objectives to realize; operations other than war or conflict, like state-building activities; insufficient funds to do everything, such as recapitalize all existing national security space assets; and the realization that *assurance* is more important than deterrence and protection.
3. In the area of commercial space, the set encompasses dynamics of globalization; impact of parastatel enterprises; erosion of the United States industrial base; the state of 2nd and 3rd tiers of the aerospace industry; necessary USG competency; risk of commercial space being used as "trade space" in respect to national security concerns; and limits on international commerce due to proliferation and security risks.

Ultimately, strategy needs to address challenges and fulfill policy in a number of ways.[57]

- Achieve unity of effort across SSA, space transportation, and commercial and government networks.
- Sustain a strategic industrial base.
- Develop an internationally accepted global climate monitoring capability.
- Formulate and implement a global exploration strategy.
- Rebuild strength in government and industry.
- Establish "circles of trust" in values and behavioral norms among space actors.
- Assure the global commons of space.
- Foster technological innovation.
- Ensure a role for markets and commerce.

[57]There are a number of ways in which strategy implementation can take shape. In the area of civil space, as an example, these range from: science-first; technology-first; and commercial-first. Science-first is focused on supporting the advancement of science. This issue is of particular concern within NASA between human spaceflight proponents and scientists that favor robotics for this end. Technology-first deals with the funding and development of new technologies as the first priority and not to commit to a specific architecture until several years from now. The argument for civil space is that the United States does not have the technology to return to the Moon and travel to Mars, at least in a way that will be sustainable and affordable. The commercial-first way is premised on the thought that the government is so incapable or grossly inefficient in the creation of space capabilities, especially compared with the private sector, that it should take an entirely different approach to human spaceflight – one that allows the private sector to develop and operate spaceflight for the government. The Obama Administration recently proposed such a commercial-first option for civil space.

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Robie I. Samanta Roy is a senior advisor across a broad spectrum of space and aeronautics technology and policy issues. Currently, he is Senior Advisor, Program Analysis & Evaluation for NASA. Prior to coming to NASA headquarters at the end of 2009, he spent four years as the Assistant Director for Space and Aeronautics at the Office of Science and Technology Policy (OSTP). There, he was responsible for a broad range of space and aeronautics-related activities at OSTP ranging from human space flight to the Next Generation Air Transportation System. He came to that position from the Congressional Budget Office (CBO) where he was the Strategic Analyst responsible for studies on military and civil space, missile defense, international relations, and other strategic forces issues. Prior to CBO, he was a Research Staff Member in the Systems Evaluation Division of the Institute for Defense Analyses (IDA) in Alexandria, VA where he conducted studies related to Command, Control, Communications and Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. He holds a Ph.D. in aeronautics and astronautics from MIT, as well as a Master's degree in Space Policy from the George Washington University and diplomas from the International Space University and Institut d'Etudes Politiques de Paris.

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Kai-Uwe Schrogl is the Director of the European Space Policy Institute (ESPI) in Vienna, Austria since 1 September 2007. Before, he was Head Corporate Development and External Relations Department in the German Aerospace Center (DLR). In his previous career he worked with the German Ministry for Post and Telecommunications and the German Space Agency (DARA). He has been delegate to numerous international forums and recently served as the chairman of various European and global committees (ESA International Relations Committee, was chairman at UNCOPUOS working groups "Launching State" and "Registration Practice"). Kai-Uwe Schrogl has published nine books and more than 100 articles, reports and papers in the fields of space policy and law as well as telecommunications policy. He is Member of the Board of Directors of the International Institute of Space Law, Member of the International Academy of Astronautics (chairing its Commission on policy, economics and law) and the Russian Academy for Cosmonautics as well as member in editorial boards of international journals in the field of space policy and law (*Acta Astronautica, Space Policy, Zeitschrift für Luft- und Weltraumrecht, Studies in Space Law/Nijhoff*). He holds a doctorate degree in political science, lectures international relations at Tübingen University, Germany (Honor professor) and has been a regular guest lecturer at the International Space University and the Summer Courses of the European Centre for Space Law.

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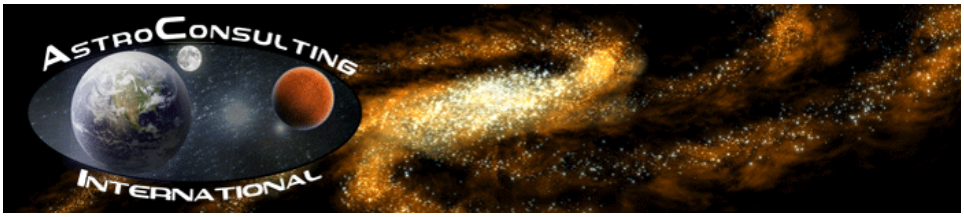

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About Secure World Foundation

Secure World Foundation is a private operating foundation dedicated to maintaining the secure and sustainable use of space for the benefit of Earth and all its peoples.

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