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GOVERNMENT'S ROLE IN COMMERCIAL SPACE FROM THE PERSPECTIVE OF EMERGING INDUSTRY LEADERS

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Government policy has the inherent ability to significantly influence business sectors. The commercial space industry, which is not unlike other industries in this respect, is particularly shaped by the government's roles as a customer, regulator, supplier, and investor. At the same time, the established commercial space sector faces uncertainties in many business and risk-related areas that are, or could, be influenced by government policy. As it stands, the collection of policies in the United States that provide an outline for behavior within the American private space industry originate from several government agencies. The current impact of government activities, as well as how their future evolution will affect industry development, is the core focus of this paper. The analysis of the effects and future developments of government policy was provided by young professionals and students from a representative cross-section of the industry brought together for the 2nd Emerging Space Industry Leaders Workshop (ESIL-02) in Washington, D.C., held in March 2012. The specific points of emphasis for this paper were identified and explored by the representative attendees of the ESIL-02 workshop and include both broad, cross-cutting strategies and specific actions. The observations and opinions of the assembled emerging leaders will be made available to those agencies and elected representatives who may find them of interest in the development and evolution of policies relating to commercial space in the United States. The very nature of commerce in the 21st century will undoubtedly result in broad international applicability of many of the observations and recommendations originating from the workshop, its paper summary, and subsequent efforts. The findings in this paper are a single perspective in the necessary ongoing dialogue of government and commercial interactions within the space industry. The conclusions and content of this paper represent the personal opinions of the ESIL-02 workshop participants and in no way should be perceived as the position of any organization or entity with whom the attendees may be employed.

I. INTRODUCTION

The views and opinions of young professionals and graduate students are perspectives not often included when considering long-term planning and strategic policies. The experiences of seasoned authorities are incredibly valuable in such efforts, and therefore, logically, these authorities traditionally become the thought leaders for such products as legislation or panel reviewed roadmaps. However, the motivation for this

paper and its originating workshop postulates that additional input from those who will be tasked with executing long-term plans, as well as those preparing to create or lead organizations that must operate within the environment created by contemporary policy decisions, is incredibly important.

I.I OBJECTIVES

The Emerging Space Industry Leaders (ESIL) Workshop series was initiated with this purpose in mind. These workshops aim to bring together graduate students and early- to mid-career professionals, with relevant technical and policy experience in the space industry, who have shown a propensity for leadership within their respective organizations. The specific intent of the second workshop of the series is documented in this paper.

Programmatically, the ESIL-02 workshop had two specific objectives for participants:

1. Identify the role of the United States Government as a customer, supplier, regulator, and facilitator of the commercial space sector
2. Identify how these roles could/should evolve in the future

In working towards these objectives, the potential roles of Government were thoroughly explored and debated, particularly within the context of their effects on industry competitive forces. Detailed conclusions on each role will be discussed in subsequent sections.

A culminating briefing was given to senior officials within the Federal Aviation Administration's Office of Commercial Space Transportation and other invited government representatives. Further dissemination of these findings will continue through the distribution of this paper.

I.II METHODOLOGY

The objectives outlined above were accomplished through the assembly of a diverse and knowledgeable group of key emerging leaders from the U.S. space sector with experience in government, industry, and academia. With the deliberate intent of enriching discussion and boosting the thoroughness of the activity, current industry leaders with experience in commercial, civil, defense, and policy organizations were included as guest speakers during the workshop. Through this convergence of fresh perspectives and decades of experience, relevant and substantial conclusions were drawn from the workshop.

An additional goal for all of the workshops in the series is to connect emerging leaders both with their peers and with current industry leaders. Doing so strengthens the space industry in general and allows new and established leaders to learn from each other's unique viewpoints.

I.III DEFINITIONS

For purposes of this evaluation, the definition of commercial space articulated in the 2010 U.S. National Space Policy was used as stated below:

"[Commercial space] Refers to space goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the activity, operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment, and have the legal capacity to offer these goods or services to existing or potential nongovernmental customers..."¹

Following this definition, analysis considered all sectors of the space industry from commercial satellites to commercial crew transportation to orbit. Primarily, sectors that were considered were those that are soon to be or are currently engaged in business activity and those with demonstrated or potential capability to deliver a product or service to commercial customers.

I.IV JUSTIFICATION

It is important to present the justification for the use of, and support for, commercially provided products or services by the U.S. government. This justification is particularly important within the context of seeking to define how the government should be involved. Beyond the explicit requirements of the U.S. Government to use commercial space capabilities outlined in the 2010 U.S. National Space Policy, there are several key requisite factors that must be satisfied by commercial industry to ensure that this justification remains.

First, commercial delivery of capabilities should provide a needed service or product to the government at a lower cost than would be required for the government to provide the same service on its own. This cost efficiency enables government mission objectives to be attained with fewer financial resources. A second important factor is the existence of innovation and continuous increases in efficiency due to the competition created by commercial forces. These attributes are rarely found at comparable levels within monopolistic environments, including those operated solely by or for the government. Yet another benefit of commercial space is its promotion of fundamental economic competitive strength in the United States. Published figures projected by the Aerospace Industry Association show that the United States balance of trade in the aerospace sector for 2011 was positive in excess of USD \$57 billion.²

This non-exhaustive list of benefits is intended primarily to state that commercial space is the right solution for many reasons but is not the only solution for acquiring products or delivering services. The tenants of benefit provided by commercial must be retained through policy and implementation in order to be justifiable.

II. ROLE OF U.S. GOVERNMENT

The Federal Government of the United States of America is involved in many aspects of most commercial industries. At a high level, these roles can be broken down as customer, regulator, and facilitator.

The Government's role as customer is straightforward in concept but becomes complicated in practice. The purchasing of goods or services from commercial companies is a frequent occurrence in Government agencies at all levels. For example, the Federal Government designs and builds neither smart phones nor automobiles, yet both are heavily used by agencies and agents in service of the Government. As the commercial space industry continues to evolve, the Government has found ways to similarly purchase goods and services, instead of developing the capabilities internally. A prime example is NASA's Commercial Resupply Services (CRS) program, which will pay private companies for the service of delivering cargo to the International Space Station, at a far lower cost than any other system in use. The purchasing of data bandwidth on commercial communications satellites for service of both civil and military needs is another example. Furthermore, the development of commercial remote sensing capabilities from space is often leveraged by various agencies and entities to fulfill their unique needs in place of developing dedicated capabilities.

Regulating and monitoring industrial activity is extensive in most industries. The ways in which regulations are crafted, monitored, and enforced can shape the competitive landscape of any industry. Again, this is no different in the commercial space industry. Whether the government is monitoring environmental impacts, coordinating the use of the radio frequency spectrum, or ensuring the safety of the public, this activity is ever-present throughout the operations of any commercial space activity. Management of trade is also included in the Government's regulatory domain, and technology export control is of particular relevance to the commercial space industry. The same regulations put into place to protect our national security have the potential to positively or negatively impact the competitiveness of commercial entities.

For this discussion, the Government's role as facilitator is defined with regard to both domestic and

international activities that impact an industry. Within the United States, the Government plays a role in supporting and fostering workforce and technology development. Frequently, the original intent of such involvement is to meet specific needs unique to the Government, but it often results in unintended benefits to industry as a whole. For example, the geopolitical competition centered on landing a man on the moon that led to the Apollo program of the 1960s also generated a major increase in technology development. Internationally, the Government's facilitating role involves resolving issues of global scope. This requires actions such as the negotiation of treaties, the establishment of global standards, or the provision of security by military and/or diplomatic initiatives. Such activities serve to facilitate and enable commercial endeavors of all kinds.

The aforementioned roles are meant to represent a high level review of how the United States Government is involved with commercial enterprise broadly and how it influences the commercial space industry more specifically. Although the description is not complete in nature, it seeks to outline the context within which the subsequent observations and recommendations of this paper are to be made.

III. FUTURE EVOLUTION OF U.S. GOVERNMENT ROLE

III.I CUSTOMER

While Government spending accounts for a large portion of established space activities globally, it also plays a role within the context of emerging sectors of the commercial space industry. In these sectors, as new capabilities are developed, Government procurement can stimulate subsequent industry growth. This prominent role in both established and emerging sectors of the commercial space industry, as well as the critical nature of many commercial space products and services with regard to national security, results in a need for the Government to act as a responsible customer.

The influences of national security, international policy, and high development risk inherent in the space industry often lead to complex value chains for both commercial and government participants. Innovative relationships such as public-private partnerships can satisfy the diverse demands of these constituencies in an effective and efficient manner. These forces, the results of the close alignment between commercial and military capabilities and activities, are somewhat unique to the commercial space industry.

It is the view of the authors that there are several qualities that define a responsible or "good" customer in the context of Governments' role in the space industry.

These include the use of appropriate contracting instruments, the establishment of consistent and clear program objectives and design requirements, the use of existing commercial options to the maximum feasible extent, and the encouragement of fair competition wherever possible.

The first and most immediate factor in the role of a customer is the contracting instrument the customer employs. Naturally, different procurement situations call for different contracting schemes based on the nature and quantity of the particular system or service desired. Contracting instruments by the Government generally fall under traditional contracting based on the Federal Acquisition Regulations (FAR), or other transaction authorities (OTAs), most notably by means of Space Act Agreements (SAAs).

Criticisms of traditional contracting under FAR mainly derive from its high levels of complexity, which lead to increased cost, prolonged schedules, contested awards, and greater barriers of entry for new or smaller market entrants.

These criticisms, combined with an emerging political need to reduce government spending and a new strategic direction in national space policy, result in a logical recent focus on the benefits of alternative means for procurement, particularly SAAs. SAAs have most notably been employed by the National Aeronautics and Space Administration (NASA) for the Commercial Orbital Transportation Services (COTS) and Commercial Crew Development (CCDev) (later Commercial Crew integrated Capability (CCiCap)) programs. Use of these instruments, referred to more generically as OTAs, has occurred repeatedly outside of NASA to perform research, development, and prototype projects. When executed correctly, this contracting vehicle has attracted involvement from commercial firms that traditionally avoid Government research and development activities, thus increasing potential technology and industrial options. More importantly, such contracting has demonstrated the capacity to “produce results better, more cheaply and more quickly than contracting under FAR.”³ The rapid development of launch vehicles and spacecraft under NASA’s commercial endeavors, as compared to traditional programs, is a prime programmatic example of the success of OTAs.

Further, in a time of fiscal uncertainty, with constantly changing budgets, traditional cost-plus contracts can increase costs; valuable time, resources, and money are allocated to restructuring and renegotiating contracts when funds fall short of the estimate. The use of OTAs also allows for private company investment, producing an even greater reduction in cost to the customer.

To make the best use of the capabilities of these non-traditional acquisition methods, certain

characteristics are required in the Government acquisition process. Acquisition officials and those formulating acquisition agreements must be educated and informed about what is legally possible. These officials must also be empowered by leadership within the Government to find the *best* solution to developing new systems instead of simply the *easiest* solution. In this way, research, development, and prototype programs will be able to fully leverage commercial capabilities and capacity for innovation.

The second essential quality of a “good customer” in space procurement is the provision of consistent and clear requirements to industry. This can be challenging, as program objectives, budget allocations, or unforeseen design challenges are realities of all advanced technology programs. This challenge is exacerbated when industrial base concerns are coupled with technical requirements. Since these factors are usually unavoidable on a program level, the focus must be on creating a robust, yet flexible, program with the ability to cope with perturbations. This necessitates a high level of transparency, objective actions, and an appropriate user interface on the part of the Government customer. Given these attributes, industry is able to satisfy the specific needs of the Government customer even through times of uncertainty.

While the first two qualities of a good customer focus on creating opportunities and drafting requirements for new commercial capabilities, the third factor is to fully leverage existing commercial options. Although this approach may require some creativity in mission design and cannot easily be applied to new or unique capabilities, it has the potential to significantly reduce cost while seamlessly integrating with the ongoing activities of the commercial space industry. Maximizing the use of existing “commercial off-the-shelf” (COTS) solutions provides a much more affordable solution at only slightly reduced capability (e.g. an adequate “80% solution”). Although already common on the subsystem and component level, there have been significant and creative applications of COTS concepts on a larger scale, such as the adaptation of the Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA) as a primary structure for the LCROSS lunar mission.⁴

Furthermore, the RAPID catalog put forth by the NASA Rapid Spacecraft Development Office (RSDO) serves as another example of an alternative contracting method, which aims to expedite the development and procurement process of certain spacecraft via Indefinite Delivery/Indefinite Quantity (IDIQ) contracts.

Other applications of existing commercial capabilities should include more extensive exploitation of secondary payload capabilities on launches, as well as hosted payloads on commercial satellites. While there will always be complications when seeking to find

win-win partnerships in this area, industry has expressed interest and readiness to accommodate hosted government payloads. To enable this collaboration, government procurement culture and programmatic structure must be re-evaluated to increase its flexibility, responsiveness, and capability-driven requirement generation.⁵

Ultimately, Government actions during the procurement of space systems or services must encourage competition wherever possible. Although maintaining a healthy competitive market is made difficult by many intrinsic factors of space activities, such as low flight rates and long development times, driving procurement to a more commercial model is a proven strategy for fostering such competition given appropriate non-Governmental market demand. Current practices, primarily influenced by national security requirements for assured access to space, have led to a lack of robust domestic competition. Government use of existing and emerging capabilities for launch across agencies has the potential to deliver competition and ultimately cost reduction. It is the finding of the workshop participants that the Government should, at minimum, avoid preventing competition and, where possible, encourage such competition where the market is sufficient to support it.

Competition is required to control rising costs, as well as provide alternatives in case of supply chain issues from a strategic perspective. Additionally, maintaining a diverse supplier base requires sustained contracts and predictable procurement trends. Therefore, it is important to recognize the real and financial value of long-term strategic planning and minimizing program stops and re-starts.

In summary, there are many specific attributes of Government acquisition that can foster broader involvement and more efficient delivery of space products and services, leveraging involvement by commercial companies both large and small. The first of these required changes is in the understanding and empowerment of contracting with appropriate instruments that include, but are not limited to, OTAs. The second required focus must be to have consistent program objectives and objective interfaces with suppliers. Finally, the Government should take full advantage of commercially available capabilities regardless of the cultural or programmatic barriers that may need to be overcome.

III.II REGULATOR

The Government's role as a regulator in the space industry is diverse, and authority is dispersed over multiple responsible agencies. While many of the regulations for launch and re-entry were consolidated behind the Federal Aviation Administration through the

Office of Commercial Space Transportation, there remains some uncertainty on authority for on-orbit operations and across some agency domains. Agencies active in regulating space activities include the FAA, the Federal Communications Commission (FCC), the National Oceanic and Atmospheric Administration (NOAA), the Department of Commerce (DoC), the Department of Defense (DoD), the Environmental Protection Agency (EPA) and the Department of State (DoS).

The regulatory role of the FAA is evolving to meet the needs of new activities such as suborbital tourism, commercial re-entry, and commercial orbital crew mission operations. Although safety remains a critical aspect, regulators must remain conscious of added operational costs and their impact on competitiveness, especially in emerging and fledgling market segments. In the view of the authors, current FAA activity is appropriately restrained and responsibly supportive of industry growth and development, without sacrificing safety. Furthermore, overlap and uncertainty between regulatory agencies can increase costs and delay commercial space programs. Therefore, the Government should continuously undertake efforts to consolidate practices and eliminate unnecessary regulatory burdens. The need identified in this role, however, is for a clear and concise framework within Government for roles and responsibilities during commercial spaceflight activities.

Another facet of Government regulations is concerned with national security and export control. Although maintaining national security is of primary concern, current regulations restrict and/or prevent domestic companies from competing or collaborating overseas. The complexity of International Traffic in Arms Regulations (ITAR) disproportionately impacts small businesses, which often serve as hubs for innovation. Notably, many items that are restricted have since become commercially available overseas. In these cases, such regulations directly inhibit commercial space companies without providing significant national security benefits.

Furthermore, these regulations have made it difficult for foreign expatriates, who may provide unique expertise and talents from working with companies based in the United States. Given the high demand for a technically qualified workforce, such restrictions on employment are not only counterproductive, they are counterintuitive. There is an indisputable importance for national security to restrict export of certain technologies; however, this is best accomplished when done efficiently. In its current form, ITAR places broad and overly-onerous restrictions on commercial activity. It is therefore critical to continue to advance the ongoing process of

reevaluating and reforming ITAR and, in particular, the Category XV munitions list.

As a regulator, it is important that the Government continues to remain conscious of the impact regulations have on commercial operators and to clarify the authority federal agencies may exercise over commercial space operations. Regulations should not put domestic industry at a competitive disadvantage but rather promote and protect innovation. Reevaluating and reforming export control is critical in achieving this goal. Special consideration should be given to the adverse effects these regulations have on the workforce and international business activities. In the absence of reform, export control will continue to place a stranglehold on American aerospace competitiveness.

III.III FACILITATOR

The U.S. Government must increasingly assume the role of a facilitator rather than the progenitor of space commerce and innovation as the role of commercial space ventures increases in size, scope, and importance, and as future exploration architectures are defined and defense capabilities developed.

To maintain innovation and growth in high technology industries, the Government can sustain and expand research and development support. This can be a difficult area for commercial entities to support, due to a lack of long-term vision and a requirement for immediate return on investment. Within the existing structure of Government research and development, greater emphasis should be placed on incentive prizes and focused grant programs such as Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR). These activities allow for private investment in development programs and foster the creation of small innovative companies that historically drive technology breakthroughs due to their ability to accept higher risk technology programs.

Sustained innovation requires the presence of abundant skilled labor and a strong educational foundation. To this end, Science, Technology Engineering and Math (STEM) initiatives are required. Growth in high technology industries can easily be limited in the absence of the requisite well-trained workforce. This is particularly true in the commercial space industry, where a lack of technologically prepared and professionally developed employees may soon begin directly limiting growth. To alleviate these restrictions, Government can continue to expand programs that provide support for fundamental and basic research activities to colleges and universities. Through initiatives such as graduate fellowship programs and support for apprenticeship and training initiatives, Government, in conjunction with industry, can facilitate the availability of the required future

workforce. While this is not expected to be the sole responsibility of the Government, it is an opportunity for the Government to take the lead in the development of a strategic asset. Industry has a similar responsibility to aid in the training and development of their future workforce. Within the scope of this discussion, a technically trained workforce encompasses scientists and engineers, as well as technicians and skilled labor.

Similar to the Government's role in facilitating air traffic control and the protection of ships on international waters, there are certain activities that are relevant in assisting with commercial space operations. Specifically, these considerations center on space traffic and space domain coordination. Efforts supporting domestic launch facilities and associated infrastructure are an example of this type of activity. While the launch ranges in use today have extensive legacy and reliability, Government ranges should aim to build on this proven foundation by increasing efficiency and capacity, while leveraging private investment in infrastructure that will enable private activity. Additionally, effort must continue to be invested in research to reduce the impact of a high volume of commercial space launches on the national airspace.

Internationally, the Government plays an important role in assisting the coordination of the specific concerns of space situational awareness (SSA) and spectrum management/protection. Although the space domain is used heavily by commercial companies, it remains of great importance to national governments as well. By its very nature, space is unincorporated by any single nation or entity. These two factors necessitate, in some cases by treaty, the involvement of Government in managing the domain.

Space situational awareness refers broadly to knowledge of the space domain with regard to objects and their current and future locations. Coordinating this information is important to prevent collisions and the creation of additional debris in orbit. Through assistive efforts such as data sharing, use of owner-operator data, and coordination between civil and military players, the Government can dramatically improve the knowledge of objects in space while maintaining national security objectives. In the U.S., this activity is primarily managed by the United States Air Force, which maintains sensor systems and the space object catalog. Great strides have been made recently in sharing data and cooperating both internationally and with industry. Due to the significance and growing urgency of SSA, additional commitment is needed in this domain. Further, the inclusion of a civil coordinating agency is likely to assist in this collaborative effort.

Satellite communications accounts for the largest revenue-generating activity in space and is crucial for many commercial and national capabilities.⁶ In this realm, Government can assist by identifying and

addressing both intentional and unintentional jamming and spectrum interference. This involvement can be particularly effective when nations are initiating the jamming, and therefore the problem must be addressed through international avenues. In other cases, coordinating spacecraft position and transmission patterns can sufficiently de-conflict unintentional interference.

III.IV CROSS-CUTTING

An application of all three components of Government involvement is seen in the ongoing development of commercial access to Low Earth Orbit (LEO). It is the authors' opinion that commercial access to LEO for cargo and crew is a critical enabling component of long-term space industry viability. Sufficient market demand for these services has yet to provide the opportunity for demonstration and is critical to this claim. Given that such an industry would operate in accordance with commercial tenants as outlined previously, it would present mission required capabilities to the Government at a much reduced cost as compared to traditional development programs.

Commercial access in this sense is a requirement in the absence of any other viable Government solution due to international obligations for the International Space Station (ISS). With or without this domestic industry, crew and cargo services will be purchased for ISS support. Use of the ISS and other future microgravity labs has the potential to significantly promote research in advanced materials, medical fields, and other high technology sectors.

In promoting this position, the authors recognize that there is a need for risk mitigation in architectures so reliant on commercial activity. There is no disagreement on the importance of redundancy and resiliency in the systems available. Fortunately, such redundant systems are available today. In terms of cargo transport to LEO, there are currently two companies under contract with NASA to deliver cargo and one contracted to return cargo. Further redundancy is provided by systems developed and flown by Russia, the European Union, and Japan. With regard to crew, the only current access is provided by the Russian Soyuz vehicle. Given a broad preference for redundancy and domestic capability, the continued support of competitive commercial crew development is emphatically encouraged.

This case study provides the opportunity to see how the Government, serving as a customer, regulator, and facilitator, dramatically influences the industry sector. In the role of customer, the Government will provide anchor tenancy for these emerging companies, in addition to providing milestone-based funds in an effort to accelerate their development to meet Government

needs. In the role of regulator, the Government is beginning to explore the safety standards that will apply to the new industry once operational. And in the role of facilitator, the Government is working to make such commercial capabilities available to foreign governments and individuals through reforms or clarifications of ITAR and other export restrictions.

V. CONCLUSION

As has been detailed throughout this paper, Government plays an essential role in the commercial space industry due to the confluence of national security and economic interests. Leveraging commercial capabilities is not new in other realms of Government activity and, as commercial capabilities become available in the space domain, it should not be surprising that the Government is taking full advantage of them.

Based on the influence the Government can have in this sector it is instructive to convey the opinion of the authors and contributors with regard to the metrics accounted for in such decisions. In Government, decisions are commonly discussed in terms of associated jobs and the congressional districts in which those jobs exist. These decisions would likely be better made, not on the current distribution of jobs, but rather on the basis of opportunities for the growth of future jobs. Maintaining the status-quo in the space industry will very likely prove financially untenable and unsustainable in the future. With this possibility, if Government takes actions to ensure a continued supply of a highly capable workforce and provide opportunities to compete globally through reforms to export control, the space industry will respond with high technology innovation that drives economic prosperity in the future.

It is also pertinent to highlight the challenges in terms of technical development, schedule, and business viability that exist for certain sectors of the commercial space industry. Within the emerging sectors of crew and cargo transportation to orbit and sub-orbit, there is a fundamental need for accurate projections. Often in these sectors, lofty promises can result in a lack of credibility as milestones slip. Identification of challenges and acknowledgment of program realities is undoubtedly needed. Responsible actions and an appreciation for expectations will go a long way towards restoring the credibility of these commercial space sectors. Delivering the needed capabilities to Government and commercial customers will also do much to provide confidence in the industry as a whole. While the commercial space industry is extensive and established beyond its emerging components, as success is demonstrated the emerging areas, all aspects are likely to benefit.

In summary, this paper advocates for the Government to continue, expand, and emphasize many initiatives to become more effective in performing its required tasks.

As a customer, the Government should place specific emphasis on informing and empowering acquisition officials to use appropriate contracting instruments for developing technology or prototypes including, but not limited to, Other Transaction Authority. The Government should establish consistent program objectives and requirements and maintain these to the greatest extent possible. Commercial options should be used wherever possible, and competition should be encouraged where market demand is sufficient to support it.

As a regulator, the Government should continue to apply regulations judiciously while acknowledging the impact such regulations have on industry development and success. A clear articulation of authority should also be reaffirmed to clarify any uncertainty during all phases of commercial space operations. The role of protecting national security should be strengthened by reforming export control, making it more efficient and effective. In so doing, commercially available items should be moved to the Commerce Control List, which is regulated by the Export Administration Regulations, and specific review of workforce implications should be conducted.

As a facilitator, the Government should seek to promote innovation through continuation and expansion of prize structures and federal grant programs to small businesses. Support of workforce training and re-training is a joint responsibility of both the Government and industry but is an area where Government leadership may prove fruitful. In a final but increasingly critical component of facilitation, the Government should continue efforts to support space traffic and space domain coordination. These efforts in support of space situational awareness resulting in conjunction avoidance and the mitigation of intentional and unintentional jamming are currently unique to the Government in its ability to assist commercial enterprise.

Regarding access to LEO, this paper strongly endorses the continued support of commercial

companies in this endeavor. Commercial space is currently at a crossroads in many respects. Responsible industry actions, careful considerations of the risk, and appropriate Government involvement are all required for success.

In bringing together a group of emerging leaders in the space industry, the ESIL-02 workshop sought to convey a perspective on commercial space activity and the Government role therein. This representative group came together in an effort to share perspectives and learn from current industry leaders. It is through activities such as these that those participating seek to prepare to make positive contributions to the future of the space industry.

The view from of the representative group engaged in this activity is cautiously optimistic. In conjunction with current industry leaders, international peers, and appropriate Government involvement there are extensive opportunities present for the space industry. Such opportunities are expected to positively impact global economic prosperity and quality of life.

Acknowledgments

Although the FAA has sponsored this project, it neither endorses nor rejects the findings of this research. The presentation of this information is in the interest of invoking technical community comment on the results and conclusions of the research.

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