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The Clash of Sectors: Why Public Private Partnerships Can Reduce 'Coerced Cooperation' in Commercial-Government Joint Ventures

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Introduction

The commercial space sector is rapidly growing, transforming the operating environment of the space domain. There was the historic milestone of the first commercial launch of a payload into heliocentric orbit by Elon Musk's SpaceX (Stevenson and Popp, 2018). Far from being an outlier of commercial capacity, it is now possible for commercial space actors, as multi-national corporations, to be headquartered in Country A while providing launch services (among others) to Country B from the territory of Country C.

The growing capabilities of commercial actors to access the space domain, and expand the space market, is a marked change from the earliest days of space exploration. During the Cold War, state actors' pursuits defined the market opportunities for space, leaving little room for *independent* commercial actors (Jafri and Stevenson, 2018). Now, unlike the Cold War, the commercial component of the global space economy accounts for more than 75% of the nearly $323 billion global space industry (2015 estimates). The growth of the commercial space market means that there are now more buyers and sellers than just governments, and more opportunities for investments, research, development, and production than just national space programs (Hampson, 2017).

With the end of the Cold War, and the globalization of corporate production, the information—and control over the flows of that information—from space systems became important parts of global supply chains and civilian economies (Brooks and Wohlforth, 2001). Government agencies such as NASA have forged the path for commercial actors in the space domain and conversely, the United States' federal government (USG) now looks to the commercial world to maintain its capabilities dominance in the space domain. Space Policy Directive 1, released in December 2017, calls for NASA to "lead an innovative and sustainable program of exploration with commercial and international partners." (Wang, 2017) Within a few months, in February 2018, the recently reinstated National Space Council was being encouraged to accelerate the growing space commercial sector by removing bureaucratic hindrances to commercial innovation. Wes Brown and Todd May of NASA's Marshall Space Flight Center note that these cooperative efforts between the public and private sectors, in addition to furthering innovation, can also improve US national security outcomes by bridging capability gaps from shifting USG budget priorities (Bragg, 2017a).

Many experts believe that one of the best investments to expand opportunities for United States' multi- and cross-domain dominance lies in the successful joint investment of the United States' government (USG) alongside commercial space actors to increase the US technological lead (Pagano, 2018). Yet, as the commercial space market grows, there are greater numbers of private actors, some of whom have the ability to operate independently (or even disruptively) in the space domain (Astorino-Courtois and Bragg,. 2018). As such, it is important to carefully consider the conditions under which the commercial space sector (CSS) and national security space sector (NSS) will pursue joint ventures, and whether the presence of joint ventures are evidence of a consensual relationship.

We observe that space policy experts would be well-served by probing the reigning consensus that future commercial and government collaboration will by definition be consensual, especially as the commercial space sector becomes more autonomous. When commercial and government interests in the space domain intersect, joint commercial-public ventures can take on one of the following forms: *coerced*

cooperation and *consensual joint ventures*. Coerced cooperation occurs when commercial and government actors pool resources without consent, usually involving a transfer of capabilities from the commercial sector to the public sector. Disagreement between the CSS and NSS over *information control* and *technological diffusion* contributes to situations of coerced cooperation: the public sector uses its legal power to attempt to maintain USG multi-domain advantages while containing the diffusion of space domain capability to potential adversaries. We suggest that a specific type of consensual commercial-public joint venture better optimizes the USG to expand its multi-domain advantage—the public-private partnership—which we distinguish from four other types of consensual commercial-public joint ventures, namely commercial acquisition, commercial leasing, government acquisition, and government leasing.

The Overlaps and Differences of Commercial and National Security Interests in Space

The interests animating the commercial and public sectors' preferences for partnership are not identical but remain intertwined. Public interests are determined in part by political coalitions and perceptions of future threat whereas private interests are structured in part by market size and market access (Bragg, 2017a). The commercial sector requires legal structure and a degree of public investments for the space domain to develop into a sustainable market with stable property relations and secure physical assets (Peterson, 2018). The public sector requires commercial investment to produce technological advancements, systems, and cheap and cumulative returns on investment.

At the minimum, the CSS looks to the USG to fulfill a stable and safe regulatory environment that also addresses physical security concerns and protects intellectual property from domestic and foreign aggressors. As part of NSI's Virtual Think Tank (ViTTa)® expert elicitation on space, space experts identified two actors in the CSS with respect to their preferences for pursuit of joint ventures with public sector actors: "old" and "new" space companies (Pagano, 2017; Astorino-Courtois, 2018).The old space commercial sector is comprised of legacy government contractors that count on the NSS community for R&D funding, major contracts, financial stability and revenue. This sector includes companies such as Boeing, Raytheon, Lockheed Martin etc. The old space commercial sector seeks the same characteristics of a healthy contractual environment that they look for in a business-to-business relationship; often the important difference is that the USG is the best or only partner for the specific venture.

The new space commercial sector, in contrast, seeks revenue-generating opportunities in space markets in which the USG is not necessarily the main client. This sector includes companies that have successfully disrupted the commercial space market, such as SpaceX, Ripple Aerospace, Gilmour Space Technologies, D-Orbit, Adranos Energetics, etc (Stevenson, 2018). Many new space actors are not as dependent on revenue from government sources as old space companies and thus look to broader markets for revenue (Astorino-Courtois, 2018)."

The USG NSS similarly possesses preferences for joint ventures with the CSS because it stands to gain much from these ventures with their private counterparts. The USG outsources to commercial actors the timely production and delivery of innovative technology. Through joint ventures, the public sector is able to share or completely offload the burden of risk, funding for R&D and new talent to the private sector by

initiating competitive programs for their goals and targets. One such initiative is NASA's Small Business and Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs that is soliciting proposals from private industry for "research, development and technology demonstrations (Hall, 2018)." Ventures like SBIR and STTR can grow NASA's catalogue of commercial technology and allow them to pursue public aims through secondary contracts which prioritize (in theory) merit and cost effectiveness.

The NSS and CSS interests diverge in the areas of *information control* and *technological diffusion*. Information control concerns data-sharing, namely, with which entities can data generated by and pertinent to the joint venture be shared. Government discourses about practices of information control usually occur using the terms "export controls" and "classification", and occasionally are found within discussions of command and control (Bragg, 2017a). Commercial discourses telegraph concern with practices of information control using the terms "intellectual property (ownership)" and "competitive (commercial) advantage (Bragg, 2017a)." Technological diffusion refers to the process by which technological innovations and advances, inclusive of new products, new processes or new management methods, spread within and across economies through increased international trade and interdependence.

Creating an information control policy that satisfies both the NSS and the CSS is difficult because questions of control overlap with concerns surrounding data ownership and organization. The NSS has for decades restricted which actors have access to proprietary information in order to preserve asymmetric advantages over potential rivals states, whereas, because commercial actors monetize access to proprietary information, and services related to analytics derived from proprietary information, these restrictions functionally limit commercial actors' potential customer base. For example, high-resolution imagery from commercial providers combined with customized data-analytics could give a wider range of actors and potential adversaries with limited to non-existent space capabilities the ability to track both military and non- military activities and capabilities, including those that could be used to manipulate economic stability (Bragg, 2017b).

Compounding the issue of access to information and information services are concerns about the effects of technological diffusion on the distribution of military capabilities. For example, in the arena of space capabilities, technological diffusion from international trade and interdependence, including leveraging the services of commercial space actors, has enabled China to offer its own Beideu2 navigation systems to countries along the One Belt One Road (OBOR) project, despite having a less advanced economy than the United States and its allies.[1] The 2015 National Military Strategy warned that the "diffusion of technology is challenging competitive advantages long held by the United States such as early warning and precision strike (The National Military Strategy of the United States, 2015)." The technology control regimes animated by these concerns have served as critical components in denying technological advantages to adversaries. Yet, despite the potential downstream consequences of space capabilities' diffusion, not every actor with limited space capabilities seeking commercial space services does so for

[1] The One Belt One Road initiative, launched in 2013, involves China underwriting billions of dollars of infrastructure investment in countries along the old Silk Road. China is spending roughly $150bn a year in the 68 countries that have signed up to the initiative.

nefarious means; for many countries, harnessing the benefits of space capabilities may be the "key not only to maintaining acceptable levels of national security but also to promoting broader economic and social development" to fulfill duties of the modern state in defense and social welfare (Mallik, 2004). Countries that lack their own space capabilities can turn to the private sector to rapidly harness benefits from the space domain at a fraction of the time and investment of US/partners (Bragg, 2017b). These countries seeking to grow their defense and economic sectors represent a critical base for private actors in the commercial space industry to sell a variety of services, including satellite launch, which overly broad technology control regimes run the risk of truncating (Astorino-Courtois, 2018; Astorino-Courtois and Bragg, 2018; Stevenson and Popp, 2018).

Commercial space experts have affirmed the "necessity of government oversight of dual-use technologies with national security implications," but also hold that many of these oversight practices are "overly restrictive, unfair to US firms, and/or prone to 'capriciousness and opaqueness' of decisions about export controls (Astorino-Courtois,. 2018)."[2] Examples in the commercial space market where the commercial and government actors' preferences diverge over technology control regimes include: "burdensome" and/or "outdated" mandatory Federal Acquisition Regulation (FAR) requirements, International Traffics in Arms Regulation (ITAR), and other compliance requirements as major barriers to successful relations between public and private sector space (Astorino-Courtois, 2018).[3] According to the Office of Space Commerce, the ITAR regime is "designed to prevent the spread of sensitive technologies to foreign actors that could threaten U.S. interests, while at the same time allowing US companies to engage in legitimate commercial activity (Office of Space Commerce, 2017: 76)." ITAR restrictions deter commerce between US private actors and their foreign counterparts and can correspondingly negate the comparative advantage domestic private industry may have, and encourage commercial interests to divest from the US.

How Commercial-Public Sector Preference Divergence Shapes Cooperation

As commercial space continues its expansion beyond the sphere of government interests and develops technology that compounds utility and private growth, the convergent interests between public and private sectors run the risk of having less and less weight in the formation and structure of joint ventures. In addition, as commercial independence grows, both commercial and government entities have ownership of capital and assets that can be leveraged for joint ventures.[4]

Interest divergence means that joint ventures between the public and private sectors in the space domain can be, in theory, cooperative or non-cooperative in how they share and leverage resources. Cooperation entails sharing duties, risk, and rewards in a venture, whereas non-cooperation means that one sector

[2] The Bryce Space and Technology Team disagreed with this viewpoint. According to CEO Carissa Christensen: "Generally speaking, the regulatory environment around commercial human spaceflight has been favorable and the regulatory environment around commercial launch has been favorable. The regulatory environment that approves very small satellite systems and large constellations of very small satellites has also been favorable."

[3] See the input from Adranos Energetics on the small satellite community efforts at self-regulation.

[4] In this Concept Paper, capital refers to the goods required to make the product. Assets refer to the things that have value and can be made/sold/leased etc.

assumes the lion's share of the duties, risks, or rewards of pursuing a venture duties, risks and rewards. Risks and duties can be measured in terms of the capital invested, or the asset exposed to risk in the course of the venture and rewards can be measured in the capital generated or the production or transfer of asset ownership throughout the venture.

When commercial and government interests in the space domain intersect cooperatively, there are two cooperation pathways by which the commercial and government sectors can share duties, risk, and rewards in a venture: *coerced cooperation* and *consensual joint venture*. Much of what is lauded as ideal commercial and government interaction falls into this category of consensual joint pursuits.

Coerced cooperation occurs when commercial and government actors share resources without the consensual transfer of capital and assets across the dyad (usually from commercial to the public sector). Governments coerce commercial cooperation by using the power of legal restrictions or by administering the protection of intellectual property to enact or inform policy. For example, legal restrictions like International Traffic in Arm Regulation (ITAR) laws are a powerful instrument to control the trade of technology and services internationally. In addition, the administration of patents in the space domain can control the transfer and use of technology, including technology the USG has developed internally. NASA's Intellectual Property Program offers an interesting example: NASA has recognized that the commercial world can benefit from the use technology that the agency has created and withheld for some time; commercial actors, however, were not able to innovate or use the intellectual property until NASA released critical patents (Northon, 2016).

Consensual joint pursuits occur when commercial and government actors share the duties, risks, and rewards in the development of a program or capacity in the space domain, by consensually transferring capital and assets between them. The balance by which each actor fields the bulk of capital and assets for the joint venture determines in which of the five types of consensual joint venture the specific agreement falls: commercial acquisition, commercial leasing, government acquisition, government leasing, and public-private partnerships (depicted in Figure 1).

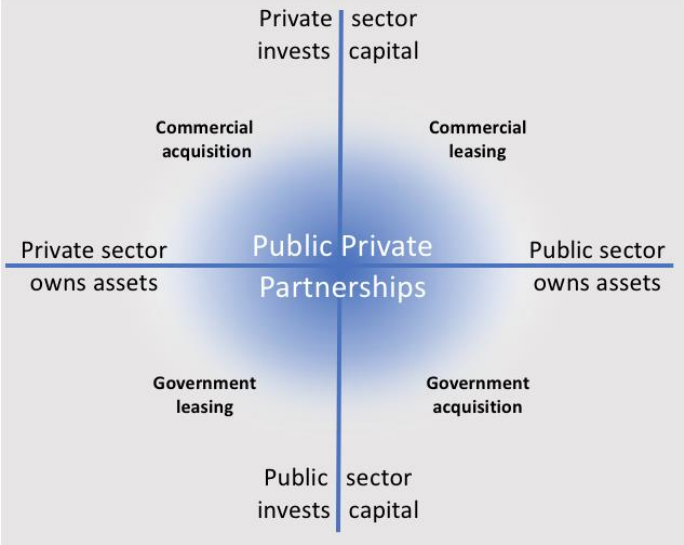
- Commercial acquisition: In commercial acquisition, on balance, the private sector provides most of the capital, and, by the end of the joint venture, most of the assets are owned or acquired by commercial actors for their use toward whatever commercial ends. An example of commercial acquisition is: Private entities purchasing decommissioned ICBM's from the DOD to convert for commercial use (U.S. Government Accountability Office, 2017).
- Commercial leasing: In joint ventures that fall within the category of commercial leasing, on balance, the private sector provides most of the capital, and, by the end of the joint venture, most of the assets are still owned or acquired by the public sector as public property but are used by commercial actors for public ends. An example of commercial leasing in the commercial space market is the leasing of NASA's Kennedy Space Center facilities (Heiney, 2015).
- Government acquisition: In government acquisition, on balance, the public sector provides most of the capital to a commercial entity for a deliverable product, good or service, and, by the end of the joint venture, the deliverables are owned or acquired by government actors for use toward public ends. Government acquisition, in some arenas, can be economically efficient when the commercial producers possess specialized expertise necessary for deliverable development, but their services are not required on an ongoing basis for public sector effectiveness. Department of

Defense procurement of satellite and other systems from private entities is a typified example of government acquisition (Mchale, 2016).

- Government leasing: In joint ventures that fall within the category of government leasing, on balance, the public sector provides most of the capital, and, by the end of the joint venture, most of the assets are still owned or acquired by the private sector as private property but are used by government agencies for public ends. By allowing the public sector to lease the use of products that already work, government leasing, in some arenas, can create cost efficiencies for the public sector; private ownership of the assets leaves the bulk of the research costs for development and improvement with the commercial actors, while creating a potentially competitive market driving down costs for use of the service or asset. Department of Defense leasing of commercial satellite bandwidth for communication is an excellent example of government leasing, when the public sector benefits from access to increased bandwidth, and the private sector, through revenue from leasing, gets capital to improve and field (better) satellites at lower costs and competition from other commercial actors seeking to capture a share of the contracting revenue (U.S. Government Accountability Office, 2015).

Consensual joint ventures can be much more than stories of efficiencies and cost savings. Involving commercial actors in public affairs can also create cost inefficiencies for the public sector and effectively serve as a subsidy to commercial entities bottom lines, particularly when commercial entities perform regular, ongoing services that are critical to the government agency's mission. When these practices regularly occur in foreign countries, these practices are denoted as "corruption." In the domestic context, these are more often described as "outsourcing" and "privatization." The four types of consensual joint pursuits identified above, of course, all run the risks of inviting corruption and inefficiency into the provision of government services because in some ways it is possible in each of those arrangements for the actor to "in-source" and wholly bear the duties, risks, and rewards of the product development. The fifth type of consensual joint pursuit – public private partnerships (PPPs)—have less risk of these incentives for corruption and inefficiencies because what results from PPPs is only possible from the union of public and private capital and assets. Public Private Partnerships (PPP's) are consensual joint ventures in which both commercial and government actors share capital investment capabilities, and asset ownership and management.

Figure 1 Mapping Transactional Cooperation



Operationalizing the Definition of Public Private Partnerships

In order for PPPs to occur, both public and private sectors must have convergent areas of operation; such salience is prominent in the various components of the space industry. in many different ways.

DARPA's Robotic Servicing of Geosynchronous Satellites ("RSGS") program, and NASA's Restore-L mission is an example of an ongoing public-private joint venture in a convergent area of operation: satellite servicing. Satellite designers make satellite hardware very reliable, in order to operate within the harsh physical environment of space; as such, generally geosynchronous satellites only come out of orbit due to a lack of fuel for maneuvering. These PPPs in satellite servicing are designed to address the challenge of refueling satellites. Once satellites can be successfully and regularly refueled, these capabilities will extend satellites' operational lifetimes and enhance satellites' ability to maneuver and support evolving mission parameters (Bragg, 2017a). In addition, a robotic servicing vehicle may be capable of actually repairing a satellite that has been damaged due to an attack, a debris strike, or mechanical failure (Stevenson, 2018).

Unlike commercial acquisition, commercial leasing, government acquisition, and government leasing which augment existing capabilities in the commercial and/or public sectors, PPPs grow and transform each sector's space capabilities by expanding resilience.[5] The 2012 DoD Directive 3100.10 offers the following definition of resilience:

> *The ability of an architecture to support the functions necessary for mission success with higher probability, shorter periods of reduced capability, and across a wider range of scenarios, conditions, and threats, in spite of hostile action or adverse conditions. Resilience may leverage cross-domain or alternative government, commercial, or international capabilities* (Bragg, 2017a).

All of the joint ventures with the USG in the space domain that meet our definition of PPP are listed in Table 1. These PPP concern launch, imagery and satellite command and control.

Table 1: Existing Public Private Partnerships (2018)

Name	Gov't Agency	Commercial Entity	Start	Conclusion	Contract Value	Notable Deliverables
Commercial Orbital Transportation Services (COTS)	NASA	SpaceX, Orbital ATK	2006	2013	$500 million investment from NASA	Innovative Launch Technology "New Medium Class Launch Vehicles" "first commercial spacecraft to deliver cargo to the International Space Station (ISS)" Pioneering PPP Model
Commercial Crew Program(CCP) (Includes three phases of CCDev1,	NASA	Blue Origin, Boeing, Paragon Space	2010	Current	8.2 billion	"provide actual cargo and payload deliveries to the station (ISS) and either cargo return or cargo removal and disposal from the

[5] The importance of strengthening the resilience of US space capabilities is directly addressed in the 2010 National Space Policy, and the 2011 National Security Space Strategy

CCDev2, and CCiCap)		Development Corporation, Sierra Nevada Corporation, United Launch Alliance, SpaceX				station." link Successful offspring of COTS
EnhancedView Program (EVP)	NGA	Digital Globe Inc., GeoEye Imagery Collection Systems Inc.	2010	2020	7.3 billion	GeoEye-2 High Res Satellite Cutting edge imagery, imagery processing, mapping and other GEOINT
Robotic Servicing of Geosynchronous Satellites (RSGS)	DARPA	Space Systems Loral (SSL)	2017	Current	N/A	Future: refueling of satellites Mechanical troubleshooting Orbital relocation assistance Attachable payloads

Note. Information for the COTS program from (Hackler & Wright, 2014). Information for CCP from (Rainey, 2015) & (Siceloff, 2015) & (Siceloff, 2014) & (Schierholz & Martin, 2015). Information for EVP from (DigitalGlobe, n.d.) & (Meisner, 2010). Information for the RSGS program from (Outreach@DARPA.MIL, 2017) & (Parrish, n.d.).

Every PPP listed in above is shaped by distinct technological circumstances and by the different needs of parties involved; as such, each PPP utilizes varying degrees of joint capital investment, asset ownership and sharing of risk duties and rewards, and in different phases of the venture.

The Commercial Orbital Transportation Services (COTS) originated from a Congressional allocation of $500 million from NASA's budget "for the instigation of commercial transportation capabilities to low-Earth orbit (namely the launch vehicles.) (Hackler & Wright, 2014)" COTS was developed at a time when the retirement of NASA's shuttle program opened a window for the commercial sector to develop capability for space transportation and fulfill NASA's need to continue operating the International Space Station (ISS) (MacDonald et. al, 2014). This venture is predicated on a near equal split of investment from both the USG and SpaceX to develop the SpaceX COTS and has since resulted in a "very robust U.S. domestic cargo transportation capability (Hackler & Wright, 2014: 95)." This PPP paved the way for other companies such as the Sierra Nevada Corporation and Orbital ATK to seek contracts for supplying cargo to the International Space System (Cofield, 2016). This venture was vital to the genesis of SpaceX and championed the success of commercial technology and its utility to the public sector.

The Commercial Crew Program (CCP) was an offspring of COTS and continued the facilitation of commercial transport developing the crew transportation system to deliver personnel and cargo payloads to the ISS and low Earth orbits (Siceloff, 2014). This program utilized the capital expertise of the public sector (in terms of manpower and other resources) in addition to commercial designs for the systems and the infrastructure and spacecraft which private entities would own and operate (Siceloff, 2014). This agreement allowed commercial actors to design and apply "efficient and effective manufacturing and business operating techniques" and then allow the commercial operators to own the assets produced in the course of the partnership (Siceloff, 2014). Competition in the bidding process ensured a good price for NASA and the best technology to emerge as a result; these technologies were highly successful and achieved the milestones set by NASA. NASA continues to utilize continual CCP contracts to both SpaceX and Boeing with crewed missions to the ISS (Foust, 2018). These launch vehicles contribute to the lasting success of the commercial sector in high-profile, public enterprises like ISS and are the bedrock for commercial exploration into space.

The EnhancedView Program (EVP) is a PPP in which the NGA provides the significant capability of data/software/tech/algorithms/other information that has been solely under the control of the NGA (as well as cash) to Digital Globe and GeoEye so that the NGA can access the advanced capability of commercial satellite imagery. Digital Globe and GeoEye in return invested a significant amount of their own capital to develop their own workforce, infrastructure and technology to benefit the NGA (Pomfret, 2012). This program has produced the boon of a "worldwide network of ground stations and online web dissemination to the intelligence community, military, and federal agencies and allies on internet and SIPRNET" in addition to high resolution imagery (DigitalGlobe, n.d.). This program was born in the geospatial environment where the commercial world far outpaced the cost-effective imagery capability of the public sector and facilitated rapid sharing capabilities across the US defense communities.

Why PPPs are the Optimal Joint Ventures for USG Advantage

PPPs represent a cooperation type in which the divergent concerns between the CSS and NSS about the effects of faulty information control and widespread technological diffusion can be both attenuated. For example, let's return to the stated goal of DARPA's Robotic Servicing of Geosynchronous Satellites ("RSGS") program, which is to offer sustainable on-orbit satellite servicing and refueling services. There are critical national security implications of these programs' success: the same capabilities which allow companies to service American satellites, could also be used against American satellites by a competitor or adversary. These concerns are not entirely idle speculation: Iran, the United Arab Emirates, and China partnered with the CSS and countries with more advanced space program and capabilities to gain their entry into space activities faster than their level of economic development may have otherwise allowed for (Bragg, 2017b). So far these capabilities have not been directly turned against the United States, its allies, or our collective assets in space; yet this is no guarantee that they could not be used aggressively in the future.

In so far as breakthroughs in the space domain offer both benefits and potential danger from a national security perspective, the NSS would likely want some say in the direction of research, and be able to limit the potential buyers of the tech. Conversely, the more regulated the technology is likely to be, the less

the CSS would want to consensually invest resources in developing a technology with limited number of buyers.

PPPs offer an equilibrium solution in which the concerns of both the NSS and CSS are addressed. The PPPs listed in Table 1 originated in areas of innovation in which the public sector either has limited ability to in-source the production process, or is demonstrably behind the technological capabilities of the CSS. Creating a consensual venture where both government and commercial prerogatives are maintained, gives the NSS a hand in directing the development of capability (through task orders and user-input) as well as being able to be a first-user/early-adopter of the latest technological capabilities in the space domain. PPPs present the optimal utilization of commercial capability while at the same time, giving the USG the driver's seat regarding situational awareness of emerging technology and how to control its eventual diffusion. The CSS, with the government as a chief sponsor and consumer of the fruits of the partnership, can gain a dedicated customer baseby way of defense procurement initiatives of the United States' allies, while also facing fewer legal barriers in developing something that the NSS wants or needs.

By allowing both sides to benefit from innovations and market size, PPPs optimize a USG strategy of containing the diffusion of commercial capability within the domain of an American advantage.

Conclusion

Commercial actors' success and advancements are creating the conditions for the CSS to seek profits in ways that may run counter to current NSS practices that limit information and technology sharing. Their success can also make them susceptible to "coerced cooperation" with the NSS through government regulation and market dominance in which commercial actors can be brought into ventures against their best judgement. Coerced cooperation occurs when commercial and government actors pool resources without consent, usually involving a transfer of capabilities from the commercial sector to the public sector. Public-private partnerships limit the incentives of both sides to act non-cooperatively.

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