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History shows that governments lose strategic initiative and primacy over national policy when commercial entities create outposts beyond the governments' reach. The impending emergence of commercially funded space operations is an indicator that nations are heading towards a problem last encountered in the Eighteenth Century. Yet, there is no research to aid identification of the incipient loss of strategic initiative or policy primacy.

This paper examines the evolution of commercial influence on national military strategy discussing three discrete examples–the English East India Company, the U.S. opening of the West, and China's recent development of African trade. In comparing indicators of rising commercial influence to the emerging commercial space environment, it finds that state authority will remain effective while orbital space operations continue to base from Earth. However, establishment of outposts farther afield will put sovereignty at risk. The paper finds that without changes to policies, strategies, and capabilities, the U.S. Government could face a loss of sovereignty over military strategy in space by the mid-2030s. The likely location of the loss of government initiative over military strategy is the Moon and the paper identifies several potential mitigations to this scenario.

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JOINT ADVANCED WARFIGHTING SCHOOL

PREVENTING COMMERCIAL COLONIALISM AND RETAINING SOVEREIGNTY OVER NATIONAL POLICY AND MILITARY STRATEGY IN SPACE

by

Daniel A. Penter

Wing Commander, Royal Air Force

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PREVENTING COMMERCIAL COLONIALISM AND RETAINING SOVEREIGNTY OVER NATIONAL POLICY AND MILITARY STRATEGY IN SPACE

By

Daniel A. Penter

Wing Commander, Royal Air Force

A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

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Abstract

History shows that governments lose strategic initiative and primacy over national policy when commercial entities create outposts beyond the governments' reach. The impending emergence of commercially funded space operations is an indicator that nations are heading towards a problem last encountered in the Eighteenth Century. Yet, there is no research to aid identification of the incipient loss of strategic initiative or policy primacy.

This paper examines the evolution of commercial influence on national military strategy discussing three discrete examples–the English East India Company, the U.S. opening of the West, and China's recent development of African trade. In articulating how, when, and why commercial entities gained primacy over national policy, the paper identifies indicators of rising commercial influence.

For the U.S., incentivization of commercial space activity through the U.S. Commercial Space Launch Competitiveness Act 2015 is creating a worldwide commercial lead in space. Research finds that state authority over the emerging commercial space environment will remain effective while orbital space operations continue to base from Earth. However, establishment of outposts farther afield will put sovereignty at risk. Governments require effective policies, strategies, and capabilities if they are to retain the strategic initiative over commercial space operations.

Potential U.S. Government approaches that may prevent the rise of commercial colonialism include the posting of U.S. Government representatives wherever there are permanent outposts, the development of new space-based military capabilities that can operate at lunar ranges, and the development of bilateral space relations with China.

Dedication

This thesis is dedicated to the men and women of the Royal Air Force who, on the first day of April this year celebrated the Service's first one hundred years.

Per Ardua Ad Astra

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Firstly, I would like to thank my family for their love, support, and understanding. I am indebted to my wife's forbearance of my irregular hours as I reverted to the nocturnal studying practices of my youth. Her prior military experience and grounded appreciation of the topic were essential as a sounding board while I developed the ideas in this thesis. Without her, I would never have had the time to dedicate to research and writing, and I consider myself fortunate to be the lesser part of Team Penter.

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Table of Contents

Chapter 1: Introduction 1

Chapter 2: Analysis Framework and Methodology 5

Chapter 3: Historical Examples of Commercial Influence over National Policy 9

English East India Company – How Merchants Set Government Policy 9

U.S. Opens the West – When Government Cedes Policy to the Citizenry 15

China in Africa – Globalization Prevents Commercial Colonialism 20

Historical Findings 24

Chapter 4: Commercial Space Environment 28

Space Environment – Physics Causes Dislocation 29

National Interests in Space – Commercial or State-Driven Celestial Expansion? 31

Celestial Market Opportunities – When Will Commercial Space Markets Open? 38

Implications of Commercial Space Operations 45

Chapter 5: Applying History to Prevent Commercial Primacy over National Policy 48

Chapter 6: Conclusion 53

Bibliography 55

Vita – Wing Commander Daniel A. Penter – Royal Air Force 62

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Chapter 1: Introduction

The recent explosion in commercial space enterprise may drastically change perceptions of security in space, forcing nations to expend lives and treasure to protect private space ventures from harm. To the uninitiated observer, the prospect of space piracy and wars spawned by commercial organizations over resources in space must seem like pure fantasy or science fiction. To military and economic historians, however, such actions have occurred frequently across the broad tableau of world history. Commercial strategic aims do not automatically align with national interests and, when in opposition the potential exists for a commercial entity to gain primacy over a state's national policy and military strategy. Should states cede the strategic initiative to commercial organizations, they effectively, in part, cede their sovereignty.

Examination of the English East India Company (EIC), the U.S. opening of the West, and China's recent development of African trade shows how commercial interests, through their influence on national policy, affect military strategy. In fact, the analysis shows the continuation of a pattern that spans the breadth of recorded history. This pattern is not science fiction and applies directly to the future of activities in space.

In the Eighteenth and Nineteenth Centuries, the EIC drove domestic and Asian policy, dominating both politics and military strategy. As America opened the West in the Nineteenth Century, the U.S. Army had to protect settlers and commercial interests while enforcing treaties between the U.S. and Native American tribes. More recently, China has deployed military forces to the Horn of Africa to protect its citizens and has entered into basing agreements in support of its Belt and Road Initiative, which is pushing Chinese commercial expansion westward toward Europe.

Analysis of the three historical case studies highlights factors that show how, and under what circumstances, commercial entities gain influence, and occasionally primacy, over national military strategy. With primacy, a commercial entity has the influence to direct a nation's policy on the use of diplomatic, information, military, or economic power. The research finds that a commercial entity's ability to direct national policy becomes evident when it can enforce diplomatic agreements, control the state's public narrative, project military effect, or regulate economic enterprise.

Commercial entities do not deploy strategies aimed at seeking primacy over government; instead, they aim to increase their competitiveness. Successful development of competitiveness involves seeking to dominate or control an existing or emergent market. The development of market domination into a monopoly over a market sector will provide long-term prosperity for a commercial entity. However, influence over national policy may occur as a by-product of the pursuit of competitive advantage. Influence over national policy becomes primacy when a commercial entity is spatially, legally, or technologically out of reach of a state. Furthermore, reinforcement of commercial primacy over national policy occurs if a commercial entity gains a monopoly over a market of vital national interest. Unless commercial and national aims align, commercial primacy over national policy will amount to a loss of state sovereignty.

The insidious rise of commercial primacy over national policy can be difficult to identify without the benefit of hindsight. Commercial primacy will initially manifest as lobbying of government and influence over instruments of national power. The flouting of international treaties at the borders of a state represents a clear indicator that commercial entities are developing significant influence. Alternatively, the granting of

state authorities to commercial entities, such as the right to sign international treaties will signal that commercial entities represent the state.

The development of commercial primacy over national policy often occurs at, or beyond, the borders of a state. Projection of state authority beyond national borders, when no international framework exists, is a military task. However, if the state military is unable to operate in locations occupied by commercial entities, then commercially raised armed forces may take their place. Without state military oversight, armed non-government nationals have the wherewithal to escalate potential conflicts and will eventually drive national military strategy.

Commercial space exploration, resource extraction, and colonization are no different from terrestrial concerns and are just as capable of gaining primacy over national policy. Current government space policy, programs, doctrine, and strategy focus on enabling terrestrial war, or protection of assets in Earth orbit. Moreover, most space-faring nations are not prepared intellectually, economically, or physically, to protect or oversee commercial space endeavors. Therefore, states are already ceding the initiative to commerce, as their engagement with space to date has primarily been earthward-facing.

Conversely, private commercial interests have focused outward from Earth. For example, within months of the U.S. Government reaffirming funding of research for a manned Mars mission in the 2033 timeframe, SpaceX founder, Elon Musk declared plans for a manned Mars mission by 2024.[1] While the dates are undoubtedly stretch targets to

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[1] *National Aeronautics and Space Administration Transition Authorization Act of 2017,* Public Law 10, 115th Cong., 1st Sess., (March 21, 2017). https://www.congress.gov/bill/115th-congress/senate-bill/442 (accessed Aug 25, 2017); Leah Crane, "Elon Musk's New Plans for a Moon Base and a Mars Mission by 2022," Newscientist.com, September 29, 2017, under "Short Sharp Science," https://www.newscientist.com/article/2149003-elon-musks-new-plans-for-a-moon-base-and-a-mars-mission-by-2022/ (accessed October 25, 2017).

generate publicity, the reality appears only a few years behind. Commercial achievement of a manned Mars mission nearly a decade earlier than the most optimistic government plans will result in governments ceding primacy to commercial enterprise.

The strategic tensions created by the disparity between government and commercial space objectives are evident when applying historical lessons to the emergent opportunities for commercial space operations. While globalization has forced greater integration of international systems, orbital exploitation and commerce will operate in a region with minimal international wherewithal to oversee treaties and law. The commercial imperative to maximize return on investment incentivizes the industrialization of space and the acceleration of technological development. Commercially driven progress will come to challenge state control and place a strain on state primacy.

The quest for monopoly over extra-terrestrial resources will drive competition over celestial real estate and generate the need for protection in a space-based frontier environment. If governments fail to provide protection in space, commercial operations will need to develop private military capabilities within the next two decades. The current trajectory of government and commercial space operations indicates a high likelihood, that once commercial entities leave Earth's orbit, terrestrial governments will cede primacy to them. If governments are to retain sovereignty over their military strategy, they require effective policies, strategies, and capabilities to prevent the reactive use of national treasure in a space-based frontier environment.

Chapter 2: Analysis Framework and Methodology

Identification of the circumstances under which a commercial space organization might achieve influence over military strategy requires development of a framework from foundational principles. Quincy Wright notes "the causes of war depend not only on the meaning of the term 'cause' but also upon the meaning of the term 'war.'"[1] For the purposes of this research, the definition of war is "an act of force to compel our enemy to do our will" and is constrained to nation-on-nation conflict either directly or through a proxy.[2] A proxy may be a commercial entity representing national interests.

In considering the cause, a commercial entity affecting military strategy and pushing a nation to war would need to comply with Clausewitz's assertion that "war is . . . an act of policy."[3] The implication is that commercial entities must have a degree of control over national policy to affect military strategy. To influence national policy, a commercial entity must exert power over national strategic interests via the instruments of national power.[4] Therefore, to cause armed conflict, a commercial entity will necessarily have affected national strategic interests and achieved influence over an instrument of national power.

For the purposes of this thesis, the influence over national policy or an instrument of national power is termed *primacy.* To gain primacy over one or more instruments of national power in a given region, a commercial entity needs to exceed the ability of the

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[1] Quincy Wright, *A Study of War*, Abridged by Louise Leonard Wright, (Chicago: The University of Chicago Press, 1983), 108.
[2] Carl von. Clausewitz, *On War*, Edited and Translated by Michael Howard and Peter Paret, (New York: Alfred A. Knopf, 1993), 83.
[3] Ibid., 98.
[4] U.S. Joint Chiefs of Staff. *Doctrine for the Armed Forces of the United States. Joint Publication 1*. (Washington DC: Joint Chiefs of Staff, July12, 2017), I-12.

instrument (e.g., more military power or greater economic wherewithal) through a combination of resourcing, influence, and technological superiority.

The circumstances leading to commercial strategy gaining primacy over an instrument of national power are not necessarily consistent from case to case. Furthermore, for a nation to cede primacy to a commercial organization, the protection of the commercial entity's position and status needs to be critical to the national interest. Additionally, the nation might cede primacy when a commercial entity is geographically out of reach, or when the commercial entity possesses greater local influence than a state.

Understanding why a commercial entity seeks to influence national policy necessitates employing the theory behind the development of commercial strategy. The rise of mercantilism in the seventeenth century focused commercial efforts on the accumulation of wealth for the benefit of the state. As mercantilism evolved into capitalism during the eighteenth and nineteenth centuries, the pursuit of economic growth became the keystone for wealth creation. In counter-point to the individual accumulation of wealth espoused by mercantilism and capitalism, Marx outlined a socialist economic system that provided growth through communal ownership and direction of economic activity.[5]

Peter Drucker indicates that a common misconception is that the principal aim of a commercial strategy is profit. Rather, in fact, survival is typically the aim, and profit merely an indicator of commercial success. While the motivations of individuals engaged within mercantilist, capitalist and socialist economies are necessarily different, the overall

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[5] Encyclopedia Britannica Online, s.v. "Economic Systems," https://www.britannica.com/topic/economic-system (accessed April 4, 2018).

aim of the larger commercial organizations remains survival. Survival depends on beating the competition. The primary commercial strategic approach in today's globalized capitalist system is to be more effective at customer creation through marketing and innovation.[6]

Drucker's thinking relating to entrepreneurial approaches provides three possible commercial strategic aims covering marketing and innovation. The first is market domination of an existing market that, at its extreme, becomes the development of a monopoly. The second aim, and most likely for the cases analyzed, is the development and domination of new markets for new or existing products and services. The final strategic aim pursued by commercial entities involves full control and monopoly of a small, niche but irreducible market.[7] In summary, achievement of competitiveness requires domination or control of an existing or emergent market.

Consideration of three historical case studies where commercial entities had the potential to gain primacy over national policy highlights the strategic drivers in the context of both national policy and commercial activity. The cases selected all feature entrepreneurial activity, opening new markets, and commercial competition against national policy. The first case, the rise and fall of the English East India Company (1600-1858), outlines two examples that illustrate how a trading corporation became an arm of the British Government, complete with a private military. The second case charts the U.S. opening of the West in the Nineteenth Century and focuses on two examples of the commercial pressures that exacerbated the diplomatic, economic, and military clash with

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[6] Peter F. Drucker, *The Essential Drucker*, (New York: HarperCollins Books, 2001), 18-27.
[7] Ibid., 161-181.

the Native American tribes. The last case examines China's commercial expansion into Africa, noting that close supervision of Chinese commerce means that commercial strategies support national aims. Even then, however, military strategy is subordinate to economic aims.

Analysis of each case study in Chapter Three demonstrates the presence and effects of commercial influence on national policy, including the circumstances under which commerce influenced military strategy or achieved primacy over national policy. Study of the modus operandi of national and commercial entities enables articulation of the key factors that will define future competition between commercial and national strategies in space.

Chapter Four outlines the emerging commercial markets on the Moon, Mars, asteroids, and within Earth orbit to assess and anticipate how commercial influence may develop over national policy. Constraining the assessment to the next two decades allows Chapter Five compare the key factors that historically enable commercial primacy over national policy and identify areas where the U.S. is most likely to suffer a loss of sovereignty to commercial entities. It concludes by outlining some potential mitigation actions for the U.S. Government.

Chapter 3: Historical Examples of Commercial Influence over National Policy

Throughout the span of recorded history, war and economics have intertwined in the spread of civilization and the clash between nations seeking dominance of ideals, culture, and geography. Thucydides' history, written "as an aid to the understanding of the future," records the rise and fall of Athens in the Fourth Century B.C., and is the first detailed historical account that shows the interplay between trade, politics, and war.[1] While insufficient evidence exists to argue that trade interests drove Athens to war, one of the key causes of the Peloponnesian War was the Megaran Decree. Holding huge benefits to Athenian produce traders, the Megaran Decree "[excluded] the Megarans from the use of the Athenian harbors and of the market in Athens," a policy that would prevent overland trade to Athens while stopping sea trade with the rest of its empire.[2] In pre-war negotiations, it was the one major concession Sparta requested and Athens refused.

After the demise of the Athenian Empire, the collapse of the Roman Empire gave way to the Dark Ages. Despite the variety of hegemons, each acted to align and expand its political, economic, and military influence. The Religious Wars that culminated in the Thirty Years War (1618-1648) tore Europe asunder until the 1648 Treaty of Westphalia ushered in a new state-based paradigm that, in Europe, enabled the rise of Mercantilism.[3]

English East India Company – How Merchants Set Government Policy

The rise of mercantilism in Europe drove a huge expansion in world trade from 1600 onwards. Competition between the English East India Company (EIC) created by

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[1] Robert B. Strassler, *The landmark Thucydides: A Comprehensive Guide to the Peloponnesian War,* (New York: Free Press, 1996), 16.
[2] Strassler, 80.
[3] Gijs Rommelse, "The Role of Mercantilism in Anglo-Dutch Political Relations, 1650-74," *The Economic History Review* 63, no. 3 (2010): 591-611.

royal charter in 1600, and Dutch East India Company created in 1602, dominated the commercial expansion in Southeast Asia and India. Each company sought to gain monopolies in the niche markets among the Spice Islands in Southeast Asia. To this end, they pursued aggressive coercive strategies to achieve subjugation of, or beneficial agreements with, the native residents. The English Navigation Act (1651), an echo of the Megaran Decree, sought to limit Dutch trading and reinforce national government support for both Dutch and English merchants. The ensuing Anglo-Dutch rivalry and subsequent wars set the conditions for the rise of the EIC. Before its fall in the late Nineteenth Century, the EIC developed virtually all the powers of a sovereign state and dictated British policy in Asia for two hundred years.[4]

In the Seventeenth Century, getting to India, or further to the Spice Islands, involved a 4-6-month voyage by sea. Trading ships carried communications, so the fastest message and response required at least eight months. Moreover, there was fierce competition for control of trade between these distant locations and Europe due to a range of novel products generating new, profitable markets. In 1600, English royal charters granting monopolies for specific products or regions were the primary control mechanism for the rising English mercantilists. By the late Seventeenth Century, after the English Civil War, Parliament gained control over the royal charters and abolished most monopolies as their charters lapsed.

In the case of the EIC, however, it did not permanently lose its monopoly until 1813.[5] While the EIC held a monopoly over English trade with India, it still needed to

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[4] H.V. Bowen, *The Business of Empire: The East India Company and Imperial Britain, 1756-1833,* (New York: Cambridge University Press, 2006), ix.
[5] Nick Robins, *The Corporation that Changed the World: How the East India Company Shaped the Modern Multinational,* (London: Pluto Press, 2006), 153.

compete with other East India Companies, primarily those of Holland and France. This case study examines the 1651 Navigation Act and the 1748 War of Austrian Succession to illustrate how the EIC maximized opportunities to gain and maintain its market share in India and thus set British Government policy.

The 1651 Navigation Act

In the early Seventeenth Century, Dutch merchants, possessing a capital base ten times that of the English, quickly established dominance over the trade between Europe and its colonies in the East Indies.[6] Several decades later, with the aim of recovering their market-share of the overseas shipping trade, the New London Merchants lobbied and bribed parliamentarians, distributed pamphlets to the public, and even got several of its members elected to parliament.[7] As a result, during "the 1649-53 [period] . . . mercantilism [was] present [in government] as a political force."[8]

The 1651 Navigation Act, enacted at the start of a 30-year economic boom, excluded Dutch flagged ships from transporting goods from English colonies and was one of the principal causes of the three Anglo-Dutch Wars between 1652 and 1674.[9] The EIC completely controlled English activity in India until the English Government, under Oliver Cromwell, refused to renew the EIC's monopoly in 1653. The loss of monopoly cut deeply into the EIC's profits such that in 1657, the EIC threatened to liquidate the company. Liquidation of the EIC would have removed English trade networks in India, so the EIC's threat forced Cromwell to renew the EIC monopoly to preserve English

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[6] Ibid., 39.
[7] Rommelse, 600.
[8] Ibid., 601.
[9] Robins, 46; Rommelse, 591.

national interests.[10] By 1688, when England and Holland ended Anglo-Dutch state rivalry though a royal marriage, the EIC had recovered from its temporary loss of monopoly and its exports from India had nearly achieved parity with the Dutch East India Company.[11]

During the period 1649-1688, the EIC successfully influenced national policy through a variety of means including lobbying, bribery, and later through control of its growing wealth. Attempts made by English parliamentarians to dislodge the EIC from its monopoly in India were unsuccessful due to the EIC's stranglehold on England's vital national trade interests.

The 1748 War of Austrian Succession

In India, given the delay in communications with Europe, both the British and the Dutch companies received permission to act in the stead of their governments. By 1740, the EIC, with authorities to negotiate trade deals through treaty or subjugation, was resident in the coastal regions of India.[12] The EIC and both the Dutch and French East India Companies competed for trade and colonial interests in the Indian sub-continent.

The War of Austrian Succession between Britain and France spilled over into the Indian Subcontinent in 1744. After Royal Navy raids against French shipping, a direct military confrontation between the EIC and the French East India Company became inevitable.[13] The end of the War of Austrian Succession in 1748 did not stop the fighting financed by the EIC against the French East India Company that would continue for another six years.

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[10] Robins, 46.
[11] Ibid., 55.
[12] England became Great Britain in 1707.
[13] Robins, 67.

By the end of its conflict with the French, experience had shown the EIC that there was profit in the use of local groups to overthrow new rulers unfriendly to favorable trading conditions. Despite the British Government "being set firmly against further territorial acquisition," from 1757 until the mid-1850s the EIC fought wars of conquest in India, eventually becoming equivalent to an imperial state.[14] By the early 1800s, the EIC had full British diplomatic rights, control of the public treasury in Bengal, and a private army that exceeded 200,000 men.[15]

The British Government attempted to curb the EIC through removal of its monopoly, but again, as in the Seventeenth Century, the EIC's economic might and political influence through bribery and coercion enabled it to protect its monopoly from all challenges until 1813.[16] The British Government had no way to enforce its writ on India as the only armed forces there belonged to the EIC. It would take commercial failure of the EIC in the early 1800s to enable the British Government to regain full control over the corporation. Even then, after its commercial empire ended in 1833, the EIC retained powers of governance over India. A British Government official commenting on EIC at that time noted that "a commercial body was 'exercising sovereignty over more people, with a larger revenue, and a larger army' than the British state."[17] This remained the case until the British Government nationalized the company in 1858, finally removing its uncontrolled influence over Indian affairs.[18]

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[14] Ibid., 4.
[15] Ibid., 23 and 47.
[16] Ibid., 148.
[17] Ibid., 153.
[18] Ibid., 164.

During the period 1688-1858, the EIC came to control British policy in India due to the granting of British diplomatic privileges, the lack of enforcement of British legal authority, and the raising of armed forces outside of government control. Even after the removal of the EIC's trade monopoly and cessation of trading, its governmental structures continued to drive British policy in India until the British Government finally gained control through nationalization.

Conclusion

While pursuing a monopoly over the market in India, an eight-month round trip from Britain, the EIC gained primacy over the execution of British policy. This primacy in India was due to the granting of British diplomatic privileges, the lack of enforcement by British legal authority, and the raising of armed forces outside of government control. While the British Government attempted to break the EIC's monopoly charter on several occasions, it suffered defeat through lobbying and bribery of officials, control of the narrative of the EIC's activities through pamphlets, and advantage over vital British national economic interests. Through its coercion, bribery, and economic power the EIC gained primacy over British national policy in India. Acquiring territory against the prevailing policy from Britain, the EIC gained virtually all the powers of a sovereign state, allowing merchants to set British Government policy in Asia for two hundred years. The British Government only overcame the EIC's power after the commercial aspects of the EIC's power had failed, and even then, it took nationalization of the EIC to overcome its influence, an action that effectively legitimized the EIC's previous actions as British Government policy.

U.S. Opens the West – When Government Cedes Policy to the Citizenry

On the other side of the globe, the Nineteenth Century saw treaty negotiations between the U.S. Government and Native American tribes aimed at opening the West and smoothing the way for an expanding population. Driven by the promise of the unique U.S. blend of freedoms and opportunities, settlers expanded U.S. territory westward into Native American lands. Seeking, among other things, individual property ownership, the settlers were in direct conflict with the communal Native American society, that believed that the strongest tribe would control lands.[19] The conflicts arising from these different cultures were amplified by the capitalist strategic approach that saw the U.S. aiming to "keep the peace, civilize the tribes, trade with them and get title to their lands."[20] As a result, the U.S. was forced to protect its citizens as they pushed westward.

Throughout the Nineteenth Century, government responsiveness depended upon speed of travel and speed of communication. At the start of the Nineteenth Century, nothing in America, whether person, produce, or information "moved faster than the speed of a horse."[21] The U.S. established governors and military outposts to set policy and protect citizens respectively. While upwards of a month's travel from Washington, the U.S. Government's representatives were within a few days travel of the locations where U.S. citizens came into conflict with the Native Americans.

However, as government policy gave way to commercial behavior, an undeclared war developed with the Native Americans, allowing economic considerations to drive the

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[19] Peter Cozzens, *The Earth is Weeping: The Epic Story of the Indian Wars for the American West,* (New York: Alfred A. Knopf, 2016) 13-15.
[20] Stephen E. Ambrose, *Undaunted Courage: Meriwether Lewis, Thomas Jefferson, and the Opening of the American West, (*New York: Simon & Schuster, 1996), 338-339.
[21] Ibid., 52.

military solutions adopted by the U.S. Government.[22] This case study examines the Louisiana Territory fur trade and the buffalo hide market as two examples of commercial opportunities that significantly influenced U.S. policy during its expansion west.

The Louisiana Territory Fur Trade

The 1803 Louisiana Purchase from the French gave the U.S. the rights to the Louisiana Territory, but did nothing to prevent encroachments into the Native American fur trade from the neighboring British and Spanish. Displacement of British fur traders formed part of the President Thomas Jefferson's justification for the Lewis and Clark expedition (1803-1806) that sought the Northwest Passage.[23] After the expedition's completion, Captain Meriwether Lewis, its leader, became the Governor of the Louisiana Territory, where his first act was to "write a major paper recommending basic Indian policy for Louisiana."[24] Fully supporting the fur trade with the Native American tribes, the policy combined pro-trade proposals to both limit the spread of new settlers, and displace the British traders in the north of the Territory.

The policy proposals defined transportation routes for migrants travelling west to limit their impact on Native Americans, while building a series of forts providing both protection for the Army and trading bases for commerce.[25] Combining the policy with his authority as Governor, Lewis was able to grant a monopoly to the St. Louis Missouri River Fur Company. While he declared no interest in the company, Lewis had assisted

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[22] Ibid., 338-339.
[23] Ibid., 78.
[24] Cozzens, 430.
[25] Ibid., 433

his nephew and William Clark, formerly of the Lewis and Clark expedition, during the company's launch.[26]

Based on Lewis' recommendations and after conflict between settlers and Native Americans, the U.S. Army built nine forts along the "Permanent Indian Frontier," a line dividing U.S. Citizens from Native Americans and straddling the routes west.[27] However, the limited numbers of U.S. Army soldiers based there could only defend the forts, having too few numbers to do much more. As a result, settlers travelling the agreed routes through Native American lands had little government oversight and were able to expand their logging and trapping beyond the agreed routes into the surrounding Native American land. The unregulated breaking of U.S. policy increased conflict between the settlers and Native Americans resulting in further attacks by Native Americans due to the erosion of their livelihood.

In the example of the Louisiana fur-trade, U.S. economic interests aligned with commercial interests of domination of the fur-trade. An individual with fur-trading interests developed the U.S. Government policy to force competitors out of the market while also achieving U.S. diplomatic aims of starting the economic integration of the Native American tribes. However, the lack of enforcement of the proposed routes for settlers through Native American lands compromised U.S. diplomatic and economic aims within a short period.

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[26] Ambrose, 444.
[27] Cozzens, 15.

Buffalo Hide Market

In 1870, at Fort Hays in Kansas, the Army needed food. Meat suppliers, armed with rifles, hunted Buffalo, removing the choicest cuts of meat and leaving the remaining carcass to rot.[28] Josiah Wright Mooar, a novice trader decided to see if obtaining the hide would be profitable.[29] The buffalo hide market was born and the huge demand from the East Coast spurred a booming market for hides that centered on Fort Dodge in southwestern Kansas.[30]

By 1872, "anyone capable of handling the deadly accurate .50-caliber buffalo rifle and mounted telescope was hired," and the buffalo hide trade decimated the Kansas herds outside of Native American territory. At that point, and in breach of treaties with the Native Americans, hunters crossed the Arkansas River into Cheyenne and Arapaho land.[31] The buffalo was a source of food and spiritual meaning to the Native Americans, so by 1874, the excessive hunting for hides coupled with U.S. Government inaction resulted in an attack on a group of hunters at Adobe Walls, in what is now Hutchinson County, Texas.[32]

The hunters, with superior weapons, emphatically prevailed and the Native Americans responded by spreading out and killing any whites they met.[33] The attack precipitated an overwhelming U.S. military response and led to the eventual displacement

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[28] Ibid., 155.
[29] Ibid.
[30] Ibid., 156.
[31] Ibid.
[32] Ibid., 155-160.
[33] Ibid., 161.

of the remaining Native Americans either into reservations or, for a few, escape across the Canadian border.

In the example of the buffalo hide market, the market was entirely unregulated by the U.S. Government; in fact, many in government saw it as an expedient way to "settle the Indian problem."[34] Driven by booming market demand, the crossing of the Arkansas River and breaching the U.S. Government's agreements with the Native American tribes became a de facto government policy. It was only a matter of time before the Native Americans responded in force against the armed hunters, who at that point may as well have been U.S. Army soldiers as they fired the first shots of a war.

Conclusion

The two examples in this case study demonstrate how well intentioned, but commercially focused, economic strategies can have second order effects on other instruments of national power. In both cases the actions of U.S. citizens, beyond the control of the U.S. Government, came to define national policy. Furthermore, U.S. Government officials and military units, only a few days travel away from the site of conflict, were unable to influence, or complicit in producing, the circumstances that caused the conflict. In both cases, non-government actors compromised diplomatic agreements and initiated conflict. The presence of armed non-government actors in the buffalo hide example highlights that, even when warranted, arming of commercial operations may lead to the risk of conflict escalation. The U.S. Government's inability or unwillingness to assert its authority over the U.S. citizenry meant that it ceded control of

[34] Ibid., 156.

national policy on the frontier and allowed commercial strategy to drive diplomatic and military actions.

China in Africa – Globalization Prevents Commercial Colonialism

Historically, the Chinese possessed a "vibrant tradition of entrepreneurship," but between the rise of the People's Republic of China (PRC) in 1949 and the end of the Cultural Revolution in 1976, the state held absolute control over the development of commerce outside China. Following the Great Leap Forward (1958-1960) and its attendant Sino-Soviet split, the PRC needed diplomatic and trade partners unaligned with either the U.S.S.R. or the U.S.[35] Therefore, in the 1960s, newly independent African countries conveniently ignored by the Cold War blocs provided ideal new diplomatic and trade partners.

Capitalizing on the links established in the 1960s, China is currently gaining entry to Africa through investment, debt-relief, and UN peacekeeping operations. "China's economy has been growing with almost unprecedented speed," creating "an almost insatiable appetite for resources," that is driving China to trade with Africa.[36] This case study examines the effects of globalization on commercial controls, and outlines China's approach to commercial activity, as it is one of the leading contenders outside the U.S. for early entry into commercial space operations.

Globalization

In comparison to the long travel times and delayed communications seen in the previous case studies, today it is possible to travel by air virtually anywhere around the

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[35] Peter Nolan, *Is China Buying the World?* (Malden, MA: Polity Press, 2012), 57; Arthur Waldron, ed., *China in Africa: A Compendium of Articles from The Jamestown Foundation's China Brief*, (Washington D.C.: The Jamestown Foundation, 2009), 2.
[36] Waldron, 4; Ibid., 7.

globe in under two days. Sea routes such as the Suez Canal coupled with modern shipping have reduced the shipboard travel times by up to a factor of six, and communications virtually anywhere on the globe are effectively instantaneous.

Commercial entities worldwide are subject to a robust system of international treaties, laws, and regulations overseen by numerous International Organizations. Multinational corporations span countries worldwide, competing to gain market share in their respective fields. Furthermore, most countries have strict monopoly laws that prevent domination by a single commercial actor. For a commercial entity to avoid this globalized system of checks and balances, its parent nation must either refuse to ratify an international standard or ignore the outcome of an international ruling. In most cases, this is rare although key incidents exist, for example, the U.S. has not ratified the United Nations Convention for the Law of the Sea (UNCLOS). Moreover, China recently ignored an UNCLOS ruling by an arbitral tribunal that found in favor of the Philippines in relation to maritime entitlements in the South China Sea including around the Scarborough Shoal.[37]

While commercial entities may seek to subvert the law to gain market advantage, they have limited options in most locations globally as they are within reach of international organizations, law enforcement, or in *extremis*, military forces. Only when nations ignore international agreements or rulings will commercial entities have the potential to act outside the law.

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[37] Lucy Reed and Kenneth Wong, "Marine Entitlements in the South China Sea: The Arbitration Between the Philippines and China," *The American Journal of International Law* 110. no. 4 (October 2016), 758.

China's Approach to Commerce

Since 1990, while the PRC retains a controlling interest over major companies in critical industries, it has begun to privatize small and medium-size companies and encourage overseas trade.[38] Moreover, China's excess industrial capacity means that, as the second largest economy in the world, maintenance of its current sustained economic growth requires the opening of new markets. Economic growth is a key factor in Chinese social stability, and the consequent protection of the Chinese Communist Party's (CCP) powerbase. Therefore, economic growth, facilitated by the import of raw materials and energy, followed by the export of manufactured goods has become a key Chinese national interest.[39]

Balancing its need to expand economically with the potential for confrontation with the U.S., China has worked to establish its economic focus in Africa while increasing Eurasian economic integration. To facilitate this activity, China is pursuing an expansion program of commercial, transportation, and resource exploitation networks under its Belt and Road Initiative (BRI).[40] China's commercial expansion in Africa means that it is becoming a major investor in emerging African economies. However, China's approach has caused unrest due to its flooding of local job markets with cheap Chinese labor. Fortunately, colonialism in the style of the EIC is not possible due to international oversight meaning that even if they wanted to, Chinese companies do not have the latitude to subjugate and exploit native residents.

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[38] Nolan, 57-60.
[39] Joel Wuthnow, *Chinese Perspectives on the Belt and Road Initiative: Strategic Rationales, Risks, and Implications*, (Washington D.C.: National Defense University Press, 2017), 7.
[40] Ibid., 3-4.

China's focus on countries that have fewer links with the U.S. means that Chinese commercial entities reside in many of the most politically turbulent countries such as Nigeria, Sudan, and Angola. With China's economic policy appearing to be a major part of its overall national strategy, it is inevitable that wherever Chinese nationals work, the state will need to provide diplomatic or military protection. The ability to protect citizens is a measure of a nation's power, and so protection of civilians is a vital national interest. The relative political instability around many of the Chinese commercial locations means that diplomatic measures may not be sufficient to protect civilian nationals.

Therefore, a military presence may need to be onsite or within reach to ensure the safety of Chinese workers in some of the less stable countries. To mitigate instability, China has supported the status quo through investment in infrastructure, financial support, and provision of military hardware to host governments.[41] During crises, China has demonstrated its capability to conduct Non-Combatant Evacuation Operations (NEOs) several times within the last decade, most notably in 2011 when it evacuated 35,000 Chinese Nationals from Libya. Until recently, outside of peacekeeping and military advice missions, China had no military bases in Africa. However, the recent construction of a port in Djibouti will provide an entry point into Africa as well as a base for anti-piracy patrols.[42]

Conclusion

The export of Chinese industry coupled with the availability of cheap Chinese labor has enabled China to leverage its strong financial position to locate both

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[41] Waldron, 11.
[42] Gregory Warner and Frank Langfitt, "China Breaks New Ground on Military Base in Africa," Npr.org, April 18, 2016, under "Asia," https://www.npr.org/2016/04/18/474639376/china-breaks-ground-on-military-base-in-africa (accessed February 15, 2018).

government owned and private commercial activities in Africa. China's opening of these new markets with the aim to enhance its political and economic reach in Africa is comparable to a commercial entity's pursuit of market domination.

A vital part of China's economic strategy is the establishment of its reputation and for this, the military instrument of power is key. While the Chinese Government has not ceded control of its military action to commercial interests, the Chinese military has no choice but to follow its Government-driven economic interests overseas.

In a globalized environment, near instantaneous communications and travel time of fewer than two days to most locations mean that the international legal and regulatory framework constrains commercial entities. The only exception is if a commercial entity's parent nation is prepared to act against international consensus.

For China, control of its commercial sector means that commerce supports the Government's economic policy. In Africa, China has tended to export Chinese workers to support its commercial interests rather than locally employing Africans. The consequence of Chinese economic policy causing an increase in Chinese workers overseas is that they collectively drive a portion of Chinese military strategy. In many respects, China's strategic approach is as corporate as is it is state-like.

Historical Findings

Despite the different outcomes, examination of the EIC, the U.S. opening of the West, and the China in Africa case studies provides insight into whether a state will retain primacy over its national policy. While in all three cases no singular factor caused either maintenance or loss of primacy over national policy, the relationship between emerging markets, national interests, and the enforcement of state authorities are pivotal.

Commercial influence over national policy may start to manifest when new market opportunities present themselves. One such example is the rise of the buffalo hide market at Fort Hays. Alternatively, they may occur through a commercial entity's quest to dominate an existing market, such as the EIC's goal of dominating Indian exports. While, indications of rising commercial influence vary, in general they appear gradually against a background of growing vital national interests, and a lack of effectiveness in the application of state authority.

In two of the case studies, commercial primacy over national policy occurred when threats to vital national interests manifested. The threat to English control of Indian trade posed by the liquidation of the EIC was sufficient to force Cromwell to cede control of India to the EIC. For China, the strategic need to avoid conflict with other great powers drove it to conduct business with less stable countries, and therefore commercial interests in Africa now influence China's military posture in the region.

In all three case studies, state authority via national and international treaties, policy, and laws provided the principal constraints to commercial influence over national policy. The ineffective implementation and enforcement of state authority was a critical feature that made the difference for Britain and the U.S., both of which lost a measure of sovereignty to commercial entities.

Indications that a commercial entity was gaining influence over national policy were evident in two cases. These indications were the granting of state authorities to the EIC, the flouting of diplomatic agreements in the U.S. West, and the ability to avoid the reach of legal and regulatory bodies in both the U.S. and India. Granting of monopolies either with or without lobbying also had the potential to create a vital national interest.

Today, the spatial factors of time and distance are just as applicable in defining a state's ability to enforce its authorities over commercial entities. However, as seen in the China case-study, globalization has effectively extended the reach of individual state authorities to encompass the whole world. It is therefore difficult for commercial entities to create monopolies that have unintended national policy implications due to the degree of national and international oversight enabled by globalization. This is true even when national policy runs counter to international sensibilities, as per China's refusal to accept the recent UNCLOS ruling over the Scarborough Shoals.

While for China and its contemporaries in the early twenty-first century, globalization enables application of state authorities world-wide, the principle remains that in a frontier environment, it becomes the task of the military to project national authority where required. For frontier environments where a state is capable of projecting military power, as in the U.S. West, the state may retain a measure of control over how commercial activities affect national policy. However, if the state military does not have the wherewithal to project power due to technological capability, resourcing, or prioritization, then it is likely, as occurred in India, that commercial entities will consider raising private armed forces either for security, or to further their commercial interests.

Overall, the key factor that drives the capability of states to project power and enforce authority beyond their borders is the spatial relationship between commercial entities and the state. In India, where travel time and communication delays were in the order of months, the lack of locally based policymakers meant that the EIC assumed primacy over British Government policy. The U.S. mitigated the tyranny of time and distance through forward positioning of empowered government representatives and the

military, thus enabling local implementation of U.S. Government policy, rather than ceding primacy to non-government entities. For China, the effects of globalization have enabled the maintenance of its authority over commercial entities with only minimal application of armed forces to support stability. However, should future commercial activities find locations at the edges of, or beyond the globalized system, the return to a frontier environment will occur. In a frontier environment, the spatial relationship observed in the EIC and U.S. case studies is the key to assessing the likelihood of a commercial entity gaining primacy over national policy and military strategy.

Chapter 4: Commercial Space Environment

Since the U.S.S.R successfully launched Sputnik 1 in 1957, one sign of a world power coming of age has been the development of its presence in space. For decades, the demanding space environment ensured that chartering space activities was the preserve of great powers. The Cold War space race drove the U.S. to land on the Moon, and the U.S.S.R. to establish manned space stations in orbit.

The end of the Cold War saw the opening of collaborative Russian-U.S. space activities and increasing launches of commercial satellites. The first commercial satellite launch in 1965, pioneered by Comsat preceded a trickle, then after the release of high-resolution U.S Global Positioning System (GPS) technology in 1993, a torrent of launches.[1] Subsequently, GPS and the growing ubiquity of satellite-enabled globalization, spurred a massive surge in terrestrial applications of space, especially in the West.

Since 2000, a sharp rise has occurred in private entrepreneurial space development, mostly in the U.S., partly driven by Government incentives and partly due to personal ambition. Entrepreneurial plans extend from the realm of the realistic, factory production of satellites and sub-orbital space tourism flights, to the almost fictional asteroid mining, hotels on the Moon, and settlements on Mars.

In parallel, the People's Republic of China (PRC) has invested heavily in space, is closing the space technology gap with the U.S., and sees the development of space as a natural progression of its economic and scientific growth. With its own version of GPS

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[1] James Clay Moltz, *Crowded Orbits: Conflict and Cooperation in Space* (New York: Columbia University Press, 2014), 94-95; Anthony L. Velocci Jr., "Commercialization in Space." *Harvard International Review* 33. No. 4 (Spring 2012), 49.

almost complete, the PRC is planning a sovereign space station and has the rocket capability to launch manned missions to the Moon.[2]

For the first time since the opening of the U.S. West, a new frontier with substantial market potential is on the cusp of opening for commercial competition. While the space environment has its own challenges, the emergence of new commercial markets will create new vital national interests. Thus, the same risks of commercial entities competing with and achieving primacy over national policy will exist in space as they did for England in India, and the U.S. in the West.

Space Environment – Physics Causes Dislocation

Space is an unforgiving environment offering a supreme technical challenge to commercial entrepreneurs. Physics dominates the planning and control of all space operations that near Earth feature orbital distances ranging from 60-1,200 miles for Low Earth Orbit (LEO) to 22,300 miles for geostationary orbit. The Moon, Mars, or Solar System-based asteroids are significantly further away than objects orbiting the Earth. The Moon is 238,900 miles away, while asteroids targeted for the first mining operations have orbits that approach within 2.4 Million miles of earth. The distance to Mars varies between 35 and 250 Million miles depending on the relative positions of Earth and Mars.

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[2] Anthony H. Cordesman with Joseph Kendall, *Chinese Strategy and Military Modernization: A Comparative Analysis*. (Center for Strategic & International Studies, 2017), 431-448. https://csis-prod.s3.amazonaws.com/s3fs-public/publication/170112_Chinese_Strategy_and_Military_Modernization.pdf?Ikd72h18mXYw.mcTydjM5ljuu7cjk2AL (last accessed April 9, 2018).

Furthermore, current practice uses a route that, in minimizing fuel requirements, only has a launch window to Mars every 26 months.[3]

Communication delays for space operations are significant by modern terrestrial standards and increase as space operations get further away from Earth. Table 1 shows distances, travel times, and two-way communication delay that, apart from Mars, will remain relatively constant. For Mars, its relative position in relation to Earth has a considerable effect.

Table 1. Spatial factors affecting commercial space operations

Location	Distance (miles)	Travel time (one way)	Communication Delay (2-way)[a]
Earth Orbit	<22,300	1-day	Negligible (< 1 sec)
Moon	238,900	2.5-days	2.6 seconds
Asteroid	238,900 – 2.4 M	2.5 - 25 days	2.6 – 25.7 seconds
Mars	35 M – 250 M	8 - 10 months (window every 26 months)	6.2 – 44.7 minutes depending on relative position of Earth and Mars

Sources: Jerry Hendrix and Adam Routh, *A Space Policy for the Trump Administration,* (CNAS, October 2017), 13. https://s3.amazonaws.com/files.cnas.org/documents/CNASReport-SpacePolicy-Final5.pdf?mtime=20171023151800 (last accessed April 9, 2018); Encyclopedia Britannica Online, s.v. "Moon: Natural Satellite," https://www.britannica.com/topic/moon-natural-satellite (accessed February 15, 2018); Encyclopedia Britannica Online, s.v. "Mars: Basic Astronomical Data," https://www.britannica.com/place/Mars-planet/Basic-astronomical-data (accessed February, 15 2018); Moltz, 23; Matt Williams, "How Long Does it Take to get to the Moon?" universitytoday.com, May 12, 2016, under "Space and Astronomy News," https://www.universetoday.com/13562/how-long-does-it-take-to-get-to-the-moon/ (accessed February 15, 2018); Encyclopedia Britannica Online, s.v. "Mars: Basic Astronomical Data," https://www.britannica.com/place/Mars-planet/Basic-astronomical-data#ref514667 (accessed February 15, 2018); Encyclopedia Britannica Online, s.v. "Mars: Human Exploration," https://www.britannica.com/place/Mars-planet/Human-exploration (accessed February, 15 2018); Encyclopedia Britannica Online, s.v. "Light: Introduction," https://www.britannica.com/science/light (accessed February 17, 2018).

[a]The calculation of communication time uses the speed of light 3×10^8 m/s (or 186,282 miles/sec).

[3] Jerry Hendrix and Adam Routh, *A Space Policy for the Trump Administration,* (CNAS, October 2017), 13. https://s3.amazonaws.com/files.cnas.org/documents/CNASReport-SpacePolicy-Final5.pdf?mtime=20171023151800 (last accessed April 9, 2018); Encyclopedia Britannica Online, s.v. "Moon: Natural Satellite," https://www.britannica.com/topic/moon-natural-satellite (accessed February 15, 2018); Encyclopedia Britannica Online, s.v. "Mars: Basic Astronomical Data," https://www.britannica.com/place/Mars-planet/Basic-astronomical-data (accessed February, 15 2018); Moltz, 23.

Space is an unforgiving environment typified by vast distances causing intermittent or delayed communications and requiring days or months to traverse physically. As seen in the historical case studies, full control of commercial entities operating in locations separated by time and distance is critical to the assertion of state authorities and protection of national interests.

National Interests in Space – Commercial or State-Driven Celestial Expansion?

Most of space is seen as a celestial commons much like the sea on Earth. However, while there is a largely acknowledged United Nations Common Law of the Sea (UNCLOS), albeit not yet ratified by the U.S., no such common framework yet exists for space. Instead, there are several international treaties supported by UN General Assembly resolutions and a complex network of bilateral agreements.

The cornerstone of space-related treaties and agreements is the United Nations (UN) Outer Space Treaty 1967. The treaty states, "Outer Space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[4] However, while the UN Office for Outer Space Affairs is tasked with promotion of "the peaceful uses of outer space," there is no implementing body tasked to regulate compliance with the Outer Space Treaty.[5] Additionally, few countries are signatories to the subsequent Moon Agreement (1979) that sought to limit the use of force "on the Moon or other Celestial bodies."[6]

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[4] Hendrix and Routh, 6.
[5] United Nations Office for Outer Space Affairs, "Roles and Responsibilities," United Nations Office for Outer Space Affairs, www.unoosa.org/oosa/en/aboutus/roles-responsibilities.html (accessed April 4, 2018).
[6] UN General Assembly, Thirty-Fourth Session, Official Records, Supplement 46, *Resolution 34/68: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, (New York, 1980), IV.77-78. http://www.un.org/ga/search/view_doc.asp?symbol=a/34/46(supp) (accessed January 2, 2018).

More recently in 2004, the UN General Assembly encouraged states to "consider enacting and implementing national laws authorizing and providing for continuing supervision of the activities in outer space of non-governmental entities under their jurisdiction."[7] As a result, most nations that have a presence in space have enacted national laws. The complex patchwork of national approaches will no doubt possess loopholes, even when combined with the multitude of bilateral agreements relating to space. However, a notable gap within the fabric of space law and associated agreements is the absence of a bilateral agreement between the U.S. and China.

The absence of international regulatory oversight coupled with the lack of signatures on the Moon Agreement means that international institutions have little reach outside of geostationary orbit. Therefore, the key to the regulation of commercial space operations is identification of which nations have an emerging commercial space sector with sufficient resources to escape Earth's orbit. The national space policy and national interests of those nations with emerging commercial markets, namely the U.S. and China, will define the commercial oversight in space.

U.S. – Commercially Driven Celestial Expansion

The U.S. approach to space policy has centered on consistently pushing scientific boundaries through NASA's research and, as new technologies proved successful, developing partnerships with commercial companies. In recent years, as the commercial satellite launch market has grown, the U.S. Government has acted to incentivize the increase of entrepreneurial activity in space. In tandem, Government interest in orbital

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[7] Paul Stephen Dempsey, "National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement." *Northwestern Journal of International Law & Business.* 36. no. 2 (Winter 2016), 5.

defense has intensified due to the U.S. military's growing reliance on orbital-based information systems.

Until 2010, NASA's focus for manned exploration was the Moon. However, in 2010, President Obama shifted NASA's strategic aims, refocusing NASA on Mars, while at the same time signaling his intent to support U.S. civil space cooperation.[8] The retirement of the last Space Shuttle in 2011 marked the start of U.S. reliance on Russian launch vehicles for crewed space launch capability. This means that the transfer of crew to and from the International Space Station (ISS) has become a critical U.S. national security concern.[9] However, crewed launch vehicles, partially funded by U.S. Government requirements, are in development by SpaceX and the United Launch Alliance (ULA). These commercial programs will reinstate the U.S. domestic launch capability that, in the meantime, is subject to Congressional oversight by the Sub-Committee for Strategic Forces.[10]

Since 2011, the U.S. has significantly increased support to commercial space activities through the US Commercial Space Launch Competitiveness Act 2015. The Act aimed "to facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions."[11] As such, Title I, the Spurring Private Aerospace

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[8] Moltz, 68.
[9] House Committee on Armed Services, *Assuring Assured Access to Space: Hearing before the Subcommittee on Strategic Forces*, 114th Cong., 1st Sess., 2015, 1-2. https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg94223/pdf/CHRG-114hhrg94223.pdf (accessed December 29, 2017).
[10] Ibid.
[11] *U.S. Commercial Space Launch Competitiveness Act*, Public Law 90, 114th Cong., 1st Sess. (November 25, 2015). https://congress.gov/114/plaws/publ90/PLAW-114publ90.pdf (accessed December 30, 2017).

Competitiveness and Entrepreneurship (SPACE) Act, calls for the "commercial space industry and government to transition to a safety framework that may include regulations."[12] However, with the exception of existing regulated areas that include launch vehicles, ground stations, launch pads, and re-entry bases, it protects commercial entrepreneurs from regulation for a period of eight years until 2023.[13]

Besides the short-term restrictions on regulation, the US Commercial Space Launch Competitiveness Act provides incentives to commercial entities through its Title IV, Space Resource Exploration and Utilization Act 2015. While Title IV includes a disclaimer, stating the U.S. does not assert "sovereignty . . . over . . . any celestial body," it provides property rights enabling U.S. citizens to "possess, own, transport, use, and sell [any] asteroid resource or space resource obtained."[14] While it may face international legal challenges, this provision is the key to incentivizing the development of U.S. commercial space operations.

Orbital space is at the limits of the international community's ability to assert its authority; as such, projection of state authorities beyond orbital space will require military means. In the military domain, the U.S. National Security Space Strategy focused entirely on orbital space, which it defined as congested, contested, and competitive. Congestion, due to increasing global space activity and space debris, exacerbates the contested nature of Earth orbit resulting from the development of Anti-Satellite (ASAT) capability. The erosion of the U.S. technological lead in space means that other nations are increasingly competitive, and recent recommendations to the U.S.

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[12] Ibid.
[13] Ibid.; Moltz, 99-100.
[14] *U.S. Commercial Space Launch Competitiveness Act*, Public Law 114-90.

Government reasoned that protection of national interests in space would require space forts.[15] Indeed, high-level officials for both the U.S. and China have stated that militarization of space is inevitable.[16]

While the U.S. military focus is on the protection of capabilities in Earth orbit, the overall U.S. Government approach to space provides regulatory and legal incentives for U.S. commercial space entrepreneurs. The lack of new regulation prior to 2023 provides a deadline for the fielding of novel technology and enables competition between commercial entities to define the new market. Its national legislation for space typifies the U.S. approach to a new frontier and, as seen in the historical case study, just as in the U.S. West, government trailblazing is on the cusp of giving way to private enterprise, this time in space.

China – State Driven Celestial Exploitation

Driven by its strategic aims of achieving prestige and regional hegemony, China's space program is currently making the fastest progress globally. The flight of Shenzou 5 in 2003 marked China's achievement of the first manned spaceflight, a key milestone on its program to put a permanent human presence in orbit.[17] Militarily, China's 2013 Science of Military Strategy (SMS) focuses on orbital competition with the U.S. and recommends a policy for Chinese development of new capabilities. Some of these

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[15] Hendrix and Routh, 17.
[16] Cordesman with Kendall, 431.
[17] Yun Zhao, *National Space Law in China: An Overview of the Current Situation and Outlook for the Future* (Leiden, Netherlands: Printforce, 2016), 9.

capabilities are "space defense missions that will eventually include the use of ground-based and airborne space defense, counterspace, and space superiority operations."[18]

In terms of space exploration, it is likely that China, rather than the U.S., will be the next national government to sponsor a mission to reach the Moon either robotically or with a human crew. It has already conducted Moon mapping missions and has funding for robotic exploration in the future.[19] While China's space program does have approved human spaceflight and lunar robotic exploration programs, it does not yet have an approved manned lunar program. Therefore, China may not get to the Moon until the 2025-2030 timeframe once it has fielded its orbital space station.[20]

Technological development driven by its space program is a critical factor for China. The hope is that the space sector will achieve success in the development of indigenous technologies that will "have spillover effects for the entire [Chinese] economy."[21] Additionally, with a history of "improving other's innovation obtained through purchase, copying or [commerce]," China will likely be amenable to obtaining space technology commercially.[22]

Government regulation and oversight of China's space program is simpler than in the U.S. as it lacks the separation between military and civilian entities that exists for NASA. This is primarily due to the dual-use classification of space technology meaning

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[18] Kevin Pollpeter and Jonathon Ray, "Chapter 8. The Conceptual Evolution of China's Military Space Operations and Strategy" in *China's Evolving Military Strategy,* ed. Joe McReynolds (Washington, DC: The Jamestown Foundation, 2016), 265.
[19] Moltz, 61; Joan Johnson-Freese, *Space Warfare in the 21st Century: Arming the Heavens* (London, UK: Routledge, 2017), 73.
[20] Ibid.
[21] Kevin Pollpeter, *Building for the Future: China's Progress in Space Technology During the Tenth 5-Year Plan and the U.S. Response* (Carlisle Barracks PA: Strategic Studies Institute, 2008), 29.
[22] Ibid., 28.

that, with both military and civilian uses, it is subject to control by the Chinese Government.[23] As such, government administration measures provide regulatory control over space activity in respect of national policies. While retaining control of space launch vehicles, China has allowed a growing private sector space industry and there are already extensive rules surrounding commercial satellite operations. The pace of regulation, however, is slow and a description of China's legal regime with respect to the space industry called it largely fragmented.[24]

The potential prestige and economic benefits associated with space exploration and exploitation mean that China will continue to maintain its rapid development of space capabilities. Coupled with its pressing need to protect its growing orbital interests and intertwined commercial-military arrangements, China's development of military space capabilities will continue apace. China's overall space industry is significantly smaller than the U.S., and it is unlikely that the military-linkage will enable it to gravitate towards space tourism. However, it is likely that the Chinese military will protect Chinese commercial presence in space either through militarization of dual-use commercial entities or openly.

Conclusion

Chinese and U.S. national policies for the commercialization of space are poles apart as the U.S. is incentivizing independent commercial operations while China seeks direct control of its dual-use technologies. As it stands, the earthward facing military space policy for both the U.S. and China means that projection of state authority beyond

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[23] Ibid., 45; Zhao, 263-266.
[24] Ibid., 261-270.

geostationary orbit is not immediately available. Additionally, increasing congestion within geostationary orbit will likely focus international attention on the lack of comprehensive agreement or regulatory body overseeing the use of orbital space rather than farther afield.

However, the U.S. Space Resource Exploration and Utilization Act 2015 already neatly sidesteps national sovereignty and militarization issues by empowering non-state U.S. commercial actors. It is likely that the absence of international oversight compounded by the lack of a bilateral space agreement between the U.S. and China will exacerbate any commercial challenges to U.S. or Chinese national policy in space.

Celestial Market Opportunities – When Will Commercial Space Markets Open?

While expensive, dangerous, and technically challenging, the potential rewards of manned commercial space operations are immense. Resources awaiting extraction vary from vast asteroid-based stocks of Platinum Group Metals (PGM) and Rare Earth Minerals (REM) to Helium-3 energy reserves on the Moon.[25] Meanwhile, the orbital satellite launch market is expanding to include sub-orbital space tourism, crew changes for orbital facilities, and residential tourism in orbit around Earth and the Moon. Visions of manned missions to, and eventually a colony on, Mars drive much of the technology development. Entrepreneurs are involved in development of systems to facilitate commercial space operations in all these markets.

[25] Alison Morris, "Intergalactic Property Law: A New Regime for a New Age." *Vanderbilt Journal of Entertainment & Technology Law* 19. no. 4 (Summer 2017), 1090-1096.

Mars

Mars has been the subject of 21 unmanned American missions to date, and is the most visited planet in the solar system.[26] In the commercial realm, SpaceX founder Elon Musk has set his sights on achieving a manned mission to Mars by 2024 and, although many industry insiders believe that to be unrealistic, they agree that success is possible within a few years of the 2024 target.[27] Musk's focus is on creating a Mars settlement and his ultimate aim is to put a million colonists there within 40 – 100 years.[28]

Comparing U.S. policy statements to those from SpaceX indicates that a manned SpaceX mission could reach Mars at least five years earlier than the earliest planned Government mission. The current routes to and from Mars, minimum travel time of 6 months, and launch windows only every 26 months will assure a physical dislocation from Earth of at least 32 months. A settlement on Mars would be beyond the reach of national power, and entirely reliant on the lead commercial entity for communications with Earth.

Due to the distance from Mars to Earth, resource extraction for return to Earth is unlikely to be commercially competitive compared to extraction on the Moon or asteroids. Moreover, agreements made on Earth would be difficult to enforce at such an extended distance. With no public plans for a manned military space force in Earth orbit

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[26] Hendrix and Routh, 10.
[27] Space Exploration Technologies Corp., "Missions to Mars," Space Exploration Technologies Corp., http://www.spacex.com/mars (accessed February 15, 2018); Calla Cofield, "Feasible or Fantasy? SpaceX's Mars Plan Draws Expert Reactions," space.com, September 29, 2016, under, "Spaceflight," https://www.space.com/34235-spacex-mars-plans-feasible-or-fantasy.html (accessed February 15, 2018).
[28] Nadia Drake, "Elon Musk: Million Humans Could Live on Mars By the 2060s," news.nationalgeographic.com, September 27, 2016, under "Science," https://news.nationalgeographic.com/2016/09/elon-musk-spacex-exploring-mars-planets-space-science/ (accessed February 15, 2018).

yet, there are likely no plans for military capabilities with reach to Mars. Therefore, a Mars colony would be entirely out of reach of U.S. authority.[29]

A Mars colony will not have national policy impact in the next two decades. However, the effect of commercial targets to establish a Mars colony will be prioritization of technologies required for long-term space operations. Increased commercial focus will accelerate development of commercial operations closer to Earth and create new commercial markets that will support Mars-based operations.

Earth Orbit

The two commercial sectors currently active in Earth's orbital space are the launch of satellites and the resupply and crew-change for the International Space Station (ISS). The impending advent of re-useable, commercially operated, passenger carrying launch vehicles is set to cause a paradigm shift in the accessibility of Earth orbit. The resultant shrinking costs of launch associated with re-useable vehicles will accelerate investment into commercial space entrepreneurship both by expanding the current market and by opening future sub-orbital and orbital space tourism markets. The basing for all the markets considered for Earth Orbit will remain mostly on Earth within the next two decades, requiring only minimal permanently space-based personnel.

Commercial entities are racing to develop fare-paying sub-orbital space flights consisting of a brief flight to the edge of space, experience of freefall, and then return to Earth. While characterized as "about where human air travel was in the 1920s," sub-

[29]Michael Sheetz, "Air Force General says China is Advancing in Space Five Times as Fast as the US," cnbc.com, November 13, 2017, under "Tech," https://www.cnbc.com/2017/11/10/usaf-general-steve-kwast-china-in-space-five-times-faster-than-us.html?recirc=taboolainternal (accessed February 16, 2018).

orbital space tourism should manifest as a niche service within the next five years but will be too expensive for the mass market.[30]

Emerging plans for orbital tourism also incorporate residential stays in existing space stations or in new orbital hotels. Bigelow Aerospace is the most advanced in this market with a test module on ISS since 2016.[31] Orbital hotels though, would require crewed re-useable orbital launch vehicles to become cost effective. The commercial operator closest to achievement of re-useable crewed launches is SpaceX, which on December 15, 2017 achieved its first launch using previously flown rocket and capsule. NASA's schedule shows SpaceX's first manned test flight of a crewed capsule in 2018.[32]

Other orbital industries such as solar energy capture and orbital manufacturing are technically feasible but are currently not competitive with terrestrial markets. Estimates indicate that the cost of getting the tons of equipment and raw material required into orbit are too high. It is unlikely that these markets will be commercially viable until exploitation of space-based raw materials commences.

Space travel remains a difficult, niche activity and as such, in the short-term governments are under little threat from commercial entities gaining influence over national policy through mass-market space-based activities in Earth orbit. While

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[30] Moltz, 108.
[31] Brian Dunbar, "NASA Extends Expandable Habitat's Time on the International Space Station," National Aeronautics and Space Administration, https://www.nasa.gov/feature/nasa-extends-beam-s-time-on-the-international-space-station (accessed February 15, 2018).
[32] Mike Wall, "SpaceX Launches (and Lands) Used Rocket on Historic NASA Cargo Mission," space.com, December 15,2017, under, "Spaceflight," https://www.space.com/39063-spacex-launches-used-rocket-dragon-spacecraft-for-nasa.html (accessed February 15, 2018); Lisa Colloredo, "Commercial Crew Program (CCP): NASA Advisory Council HEOMD Committee Status," National Aeronautics and Space Administration, November 29, 2017, https://www.nasa.gov/sites/default/files/atoms/files/nac_ccp_status_nov_29_2017-2.pdf (accessed February 15, 2018).

commercial space operations will require personnel in orbit, the preponderance of the commercial infrastructure and personnel will remain based terrestrially.

Asteroid Mining

Asteroids present a major market opportunity in PGM and REM, both of which are in huge demand on Earth for use in modern technological products.[33] Incentives for commercial or national exploitation include estimates of the solar system's mineral wealth equating to "100 Billion dollars for every person on Earth today."[34] Another potential market is the mining of water that, when split into Hydrogen and Oxygen, could replenish fuel on space vehicles. The availability of off-Earth refueling would significantly increase the potential length of missions, as well as reducing launch fuel weights, and therefore increasing the payload for each launch from Earth.[35] Other beneficiaries of asteroid mining would be orbital industries, such as solar energy or manufacturing, as these industries are not commercially viable in the near term due to the volume of materials that would need launching from Earth.

Despite the technological difficulty and vast costs associated with initial asteroid mining, "Planetary Resources, Deep Space Industries, and Shackleton Energy have all expressed not just interest but intent to lead the way in various extraction activities."[36] In principle, although technological hurdles exist today, asteroid mining and movement of

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[33] Examples include communication, electronic, digital, mobile and battery technologies; and transportation, particularly aerospace and automotive emissions reduction; J. P. Sykes, J. P. Wright, and A. Trench, "Discovery, Supply and Demand: From Metals of Antiquity to Critical Metals," *Applied Earth Science* 125. no. 1 (2016): Introduction. http://www.tandfonline.com/doi/full/10.1080/03717453.2015.1122274 (accessed February 15, 2018).
[34] Morris, 1090.
[35] Ibid., 1093.
[36] Johnson-Freese, *Space Warfare in the 21st Century*, 143.

material into Earth orbit for refining could commence by 2025.[37] Planetary Resources launched unmanned spacecraft in 2015 and 2018, while 2020 will see further launches to analyze specific target asteroids to enable development of mining vehicles and missions.[38] While this extended development period is costly, the value of the potential market provides a large incentive to commercial operators to bring resources to market as early as possible to recoup costs.

Asteroid mining is currently robotic in nature, and therefore follows the same pattern as orbital markets, maintaining most support activities based on Earth. Despite the likelihood of a market crash for PGM or REM caused by asteroid resources entering the terrestrial market, commercial entities will have no choice but to recover their costs.[39] The impact of a U.S monopoly on asteroid resources entering the terrestrial market would likely become a vital national interest for China, which currently provides 90% of the world's REM market. China has previously used its virtual monopoly to control or embargo REM exports for financial and political gain.[40]

While entry into the asteroid mining market is costly, technically demanding, and not yet assured within the next decade, there are three U.S. commercial entities chasing the market. Highly incentivized to get a return on investment, should one of the U.S. commercial entities succeed in returning asteroid materials to Earth, they would provide a

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[37] Deep Space Industries, Inc., "Mining," Deep Space Industries, Inc., https://deepspaceindustries.com/mining/ (accessed February 15, 2018).
[38] Planetary Resources, "Arkyd-3R," Planetary Resources, https://www.planetaryresources.com/missions/a3r/ (accessed February 15, 2018); Planetary Resources, "Arkyd-301," Planetary Resources, https://www.planetaryresources.com/missions/arkyd-301/ (accessed February 15, 2018).
[39] Jim Edwards, "Goldman Sachs: Space-Mining for Platinum Is 'More realistic than perceived,'" Businessinsider.com, April 6, 2017, http://www.businessinsider.com/goldman-sachs-space-mining-asteroid-platinum-2017-4 (accessed February 15, 2018).
[40] Morris, 1091.

monopoly to the U.S., crash the market, and create a strategic challenge to a Chinese vital national interest.

The Moon

Commercial operations on the Moon are less technically challenging than asteroid mining and closer to realization. Moon exploration and exploitation are a focus for tourism, mining, and science. Bigelow Aerospace's goal of deploying its portable habitats in orbit around the Moon by 2025 looks achievable, and the company indicates that it may be ready to start by 2022.[41] For lunar mining, Shackleton Energy intends to "extract water from the Moon and turn it into rocket fuel to create in-space fuel stations."[42] Moreover, scientists at the National Institute for Fusion Science in Nagoya, Japan believe that the lunar surface contains about 10 million tons of minable Helium-3, which could provide nuclear energy for all of the Earth for 500 Years.[43] Extraction of the Moon's REM and PGM deposits are also a viable commercial proposition for Earth-based or orbital consumption.

Commercial missions to the Moon establishing space tourism, scientific research, and mining operations appear feasible by the mid-2020s. These activities will most likely locate, firstly in orbit, then on the surface, in a single commercial base for cost effectiveness and ease of resupply. The impact of lunar materials entering Earth markets through a U.S. monopoly entity carries the same risks of challenging a vital Chinese national interest as asteroid mining. It is likely that no U.S., other governments, or other commercial entities will establish bases on the Moon before China arrives in the early

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[41] Johnson-Freese, *Space Warfare in the 21st Century*, 143.
[42] Ibid., 144.
[43] Morris, 1095.

2030s. This means that U.S. commercial entities will have at least five years in situ prior to international contacts on or near the Moon.

Conclusion

While space travel remains a difficult, niche activity, the entrepreneurial focus on the colonization of Mars is accelerating developments that will enable commercial operations in Earth orbit, on asteroids, or the Moon. Despite a Mars colony being more than two decades away, the spaceward-facing commercial approach is outpacing U.S. Government programs and looks likely to commence asteroid mining and lunar-basing in the 2025 timeframe.

Access to PGM and REM resources from asteroids and the Moon will, when brought to market on Earth by a U.S. commercial entity, create a U.S. monopoly and crash the market. It is reasonable to expect that U.S. commercial operations on the Moon will have a monopoly until China achieves manned missions to the Moon in the 2030 timeframe. With a 90% share in the REM market, China will be the hardest hit by a new U.S. monopoly, and this may cause China to see the challenge to its market-share as a vital national interest. The cost of entering the space-mining market will incentivize commercial entities to expedite the entry into terrestrial markets to recoup their costs.

Implications of Commercial Space Operations

Space is an unforgiving environment typified by vast physical distances that cause intermittent or delayed communications and celestial separation that can take days or months to traverse physically. The 1960s saw agreements in principle for controls on the use of space, but the lack of a comprehensive regime for international governance means that individual nations have had to develop laws to regulate their non-governmental

entities. Furthermore, the lack of bilateral agreements between the U.S. and China will only exacerbate any friction caused by American commercial entities in space.

For Mars, the lack of international governance, and extended lines of communication for national oversight, means the U.S. Government will be reliant on commercial transportation, governance, and reporting. However, Mars will not become sufficiently commercially active to drive a national policy issue within the next two decades and probably not until 2060 at the earliest based on Elon Musk's most optimistic predictions. In Earth orbit, the increasing congestion of orbital space caused by commercial expansion may become a driving factor for military strategy even though the military competition there is likely to remain the preserve of national governments. However, most of the supporting infrastructure and personnel for space operations will remain on Earth, and therefore commercial entities will be within reach of the authority of their home-nations. Regulation and oversight of commercial space operations will follow extant regulatory frameworks, and as such, commercial entities operating in Earth orbit will only influence policy if they gain a monopoly over a vital national interest. The first monopoly that will affect the U.S. is SpaceX's re-useable launch vehicles, a capability already subject to continuing Congressional oversight.

Asteroid mining presents a complex issue for the U.S. Government because, as a U.S. commercial entity successfully achieves a monopoly over orbital REM or PGM mining, the market will crash. The recovery of start-up costs will drive commercial behavior, no matter the effect on terrestrial markets, so the U.S. Government will only have limited influence over a commercial monopoly. A response from China due to its loss of influence over the critical REM market is inevitable and would likely manifest as

the first international test of the U.S. Space Resource Exploration and Utilization Act. With a proven ground-based ASAT capability and, by 2025, an orbital space station, China will also possess military options such as interdiction of resources during their transit to Earth, if legal representation is unsuccessful.

In principle, commercial lunar operations should present minimal oversight issues to the U.S., as they will still be dependent on Earth for supplies, support, and home basing. Furthermore, the same international considerations and issues outlined for asteroid mining will be applicable to Moon mining. However, the physical isolation of a lunar base, and difficulty in observing its operations, will hamper government oversight of activities, making them reliant on reports from the commercial entity.

The lack of other plans for Moon landings prior to the 2030 timeframe means that U.S. commercial entities will have at least five years in situ prior to international contacts on the Moon. When China successfully achieves a manned mission to the Moon, a lunar-based commercial entity will be the de facto U.S. Government representative.

The dual-use nature of Chinese commercial space operations may present an armed threat to U.S. commercial entities and even the suspicion of an armed threat would provide sufficient pretext for a U.S. commercial entity to prepare for the eventuality. While international agreements specify that governments may not position weapons on the Moon, there is no restriction over non-government entities, an issue compounded by the lack of an international regulatory body. Therefore, once the Moon becomes a commercially contested environment, it is likely that a commercial entity will support the pre-positioning of armed capabilities and contracted non-government military personnel, a situation like that faced by the English East India Company.

Chapter 5: Applying History to Prevent Commercial Primacy over National Policy

In the next two decades, the burgeoning U.S. commercial space sector can capture several celestial markets. Commercial space operations exploiting each location or type of market will focus on achieving competitiveness to ensure continued survival. Due to the unforgiving environment and high technological threshold required for entry into the commercial space market, commercial entities that gain entry will have greater chance of developing a monopoly. When vital national interests intersect with a commercial monopoly, states will run the risk of ceding sovereignty to commercial entities.

The case studies--the English East India Company (EIC), the U.S. opening of the West, and China in Africa--highlight the factors that act for and against commercial entities gaining primacy over national policy. The indicators of rising commercial primacy over national policy derived from the case studies show that in pursuit of market domination, commercial entities could gain a monopoly over a vital national interest. All three cases indicate that legal constraints, the spatial relationship, and ability to project military power define the likelihood for a commercial entity to gain primacy over national policy.

During the rise of the EIC, its royal charter was the route to a monopoly that became a vital national interest for England. While in the U.S. case, the quest for market domination in both the fur trade and the buffalo hide market drove government policy despite not having a monopoly. The analysis of emerging space markets identifies that Rare Earth Minerals (REM), Platinum Group Metals (PGM), and orbital launch capabilities are the most likely to generate monopolies. As all the commercial entities expected to open the first celestial markets are American, the space markets will be an

item of U.S. national prestige. The likely crash in market value for PGMs and REMs will provide an opportunity for U.S. technology industries that will generate a further economic vital national interest. Therefore, the first commercial entities to gain a foothold in the space market will gain significant influence over U.S. national interests.

The case studies show that robust legal regulation mitigates or prevents the emergence of commercial primacy over national power. In the case of China in Africa, the globalized legal system is a factor that assists the control of commercial entities. Contemporary laws for space do not provide a robust framework for regulation of commercial entities. Moreover, the U.S. Commercial Space Launch Competitiveness Act 2015 reduces regulation over U.S. commercial entities until 2023 and provides a legal vehicle for U.S. commercial entities to profit from the extraction and sale of space-based materials. The reduced regulation will allow more latitude to commercial entities that may develop monopolies that could impact vital national interests. Moreover, in creating the incentives for U.S. commercial entities to open celestial markets, the U.S. Government has left a disparity between U.S. law and international expectations. The U.S. will likely face legal challenges internationally where it will have to protect commercial monopolies via diplomatic means.

In the EIC case, the findings show that when legislation lags, nations tend to become dependent on monopolized markets. It also indicates that to prevent loss of primacy over national policy it is necessary to deal with such monopolies aggressively. Potential actions to prevent the emergence of a U.S. dependence upon a monopolized space material market include the development of bilateral space agreements with China, or further U.S. legislation to protect resource markets from crashes. As the limiting of

resource markets would go against the intentions of the Space Resource Exploration and Utilization Act, a bilateral agreement with China may represent a better approach to resolving the wider legal concerns while enabling continued development of space.

The three case studies show that states are only able to enforce legal regulation where they can project their authority. The capability of states to project their authority is due to a combination of spatial considerations and the ability to project military power. The China in Africa case indicates that today, on Earth, spatial considerations are virtually non-existent as near-instantaneous communication coupled with global military reach and globalization enables enforcement of national policy through international organizations. However, the EIC and U.S. cases show that in a remote or dislocated frontier environment, suffering long travel times and communication delays, the maintenance of national authority requires the projection of military power.

Initial consideration of space-based enterprise might indicate that the extreme distances will immediately put commercial entities out of reach of governments. However, this is not the case as commercial operations in orbital space, and near-term asteroid mining will rely on Earth-based ground stations and support while only being a few days travel from terrestrial authorities. On Mars, while communication delays to Earth seem extreme compared to the terrestrial globalized environment, daily communication is still possible. However, the distance presents a completely different calculus as the travel time is akin to that last seen during the Seventeenth Century. Therefore, with spatial dislocation like the situation facing the EIC, it is a given that Mars will be outside of terrestrial national authority. The Moon presents an inflection point between the orbital and Mars scenarios as while it is close enough to Earth to experience

only minor communications delays, the commercially monopolized transportation combined with a lack of effective legal framework mean that it will effectively be outside of immediate reach of national authority.

The three historical case studies demonstrate that the key to extending the range of national authority to locations dislocated by time, distance, or both is the projection of military power. Where a military is unable to project sufficient power (U.S.), or is outmatched (India), private and commercial entities will arm themselves to assure protection or enable local rule of law. For orbital commercial activities, while terrestrial military space capabilities are earthward facing, ASAT capabilities could project power into orbit if needed. Additionally, while the development of an orbital weapons platform would break the Outer Space Treaty, there is a presumption by China that the U.S. will develop orbital weapons that is leading China to plan a counter-capability. Officials for both the U.S. and China have noted the inevitability of arming space, which may result in capabilities in orbit that would act to project national power.

As there will be no military capability near Mars for some time, it will effectively be outside the reach of state authority once it becomes a colony although that is unlikely before 2060 at the earliest. The Moon, however, is out of reach of weapons based terrestrially, and there is no indication that either the U.S., China or any other countries are planning lunar militarization. That said, for a U.S. commercial entity on the Moon, the dual-use nature of Chinese space enterprise will cause concern. Therefore, it is virtually inevitable that U.S. commercial entities will justify the pre-positioning of arms or commercial armed forces on the Moon once international competition for resources manifests in the 2030 timeframe.

The findings suggest that despite the Moon's relative proximity to terrestrial authority, it is the most likely location for the emergence of commercial primacy over national policy. The principal causes expected to contribute to commercial primacy are the emergence of international commercial competition on the Moon, coupled with a lack of effective legal regulation, the inability for any nation to project national military power, and the dislocation due to a transportation monopoly.

It is unclear how the first commercial diplomatic contacts on the Moon will play out, given the different cultural imperatives of the U.S. and China. The military-civilian dual-use approach by China assures accurate and consolidated representation of its national interests, while the commercially driven U.S. approach will prevent U.S. oversight and create flexibility for commercial entities. The U.S. cultural preference for land ownership demonstrated in its opening of the West, if manifested in space, is likely to conflict both with international agreements and with Chinese interests.

Despite the variety of differing potential scenarios and outcomes, there are few routes open to the U.S. to avoid what will become an inevitable armed civilian confrontation with China once a U.S. commercial outpost shares the Moon with other commercial entities. The two available diplomatic options are to start early discussions with China to develop a bilateral space agreement, or to appoint a U.S. Government representative to a lunar outpost as per the U.S. approach to the West. Without international cooperation, the only option remaining to the U.S. is to project state authority over commercial entities operating on the Moon by developing a military capability that can operate at lunar ranges.

Chapter 6: Conclusion

Research shows that commercial entities that gain a monopoly over resources or markets of vital national interest will wield influence over national policy. Rising commercial influence can reach a tipping point whereby it gains primacy over national policy and influence over military strategy. Where a commercial entity exists outside the reach of state authority, it will, over time and if unchecked, become the de facto national representative. Key factors leading to commercial primacy are the lack of enforceable legal standards, and spatial separation in time, distance, and technology. Furthermore, where the state military does not have the capability, resources, or prioritization to project national power, the state is unable to project its authority, ceding influence and eventually sovereignty to commercial entities.

Commercial capabilities are pushing the technological boundaries to reach Mars, an outward facing goal that is driving progress in all areas of commercial space operations. The spatial dislocation between commercial space operations and national authority presents a risk of commercial primacy developing over national policy on Earth as well as in space. In counter-point, militarily the U.S. and Chinese strategies for space focus on protection of current capabilities that are earthward facing. Consequently, as commercial entities routinely pass geostationary orbit in the late 2020s, the U.S. will no longer be able to project military power to maintain national authority over them.

Legally, with no bilateral agreement with China, the U.S. Commercial Space Launch Competitiveness Act 2015 firmly puts U.S. commercial space operations in the lead of its national exploitation of space. The U.S. initiative to incentivize manned commercial space enterprise has opened the market for those pioneers who wish to invest

in this high risk and reward environment. A dearth of national power projection in space means that once the pioneers on this new frontier depart orbit, they will be as isolated from their home nations as Lewis and Clark in the West, or the EIC in India.

While commercial primacy over Mars is a given, the reality of a Mars colony is greater than 40 years in the future. Within the next two decades, national oversight of orbital industry, including asteroid mining, is achievable under current plans as launch and re-entry sites are subject to national regulatory activities. However, on the Moon within the next two decades, if no change in U.S. policy occurs, commercial entities will gain primacy over national policy and military strategy.

With monopolies over lunar activities, U.S. commercial entities will be a major item of national prestige by the late 2020s. Once other nations such as China commence lunar operations therefore, establishment of U.S. Government representatives on remote bases is paramount to ensure accurate and timely national representation. As the U.S. military has no capability with lunar reach, U.S. commercial interests will likely decide to arm themselves to preserve their independence of action when faced with ceding a lucrative monopoly to other commercial actors such as the Chinese.

To prevent a loss of sovereignty over U.S. national policy in space, the U.S. Government needs to assert its authority over the rising commercial influence. Potential approaches to prevent the rise of commercial colonialism include the posting of U.S. Government representatives wherever there are permanent outposts, the development of new space-based military capabilities that can operate at lunar ranges, and the development of bilateral space relations with China.

Bibliography

Acemoglu, Daron and Robinson, James A. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York: Crown Publishers, 2012.

Clausewitz, Carl von. *On War*. Edited and Translated by Howard, Michael and Paret, Peter. New York: Alfred A. Knopf, 1993.

Drucker, Peter F. *The Essential Drucker*. New York: HarperCollins Books, 2001.

Freedman, Lawrence. *Strategy: A History*. New York: Oxford University Press, 2013.

Kagan, Donald. *Thucydides: The Reinvention of History*. New York: Penguin Group, 2009.

Krooth Richard. *Arms & Empire: Imperial Patterns before World War II.* Santa Barbara, CA: Harvest Publishers, 1980.

Lambert, Nicholas A. *Planning Armageddon" British Economic Warfare and the First World War*. Cambridge, MA: Harvard University Press, 2012.

Le Billion, Phillippe. *Wars of Plunder: Conflicts, Profits, and the Politics of Resources*. New York: Columbia University Press, 2012.

Nye, Jr, Joseph S. *Soft Power: The Means to Success in World Politics*. New York: Public Affairs, 2004.

McMahon, Christopher J. "Maritime Trade Warfare: A Strategy for the Twenty-First Century?" *Naval War College Review* 70, no. 3 *(Summer 2017)*: 15-38.

Ruttan, Vernon W. *Is War Necessary for Economic Growth? Military Procurement and Technology Development.* New York: Oxford University Press, 2006.

Schneider, William. *Can we Avert Economic Warfare in Raw Materials? US Agriculture as a Blue Chip.* New York: National Strategy Information Center Inc., 1974.

Sternberg, Fritz. *Capitalism and Socialism on Trial.* New York: The John Day Company, 1950.

Strassler, Robert B. *The landmark Thucydides: A Comprehensive Guide to the Peloponnesian War.* New York: Free Press, 1996.

U.S. Joint Chiefs of Staff. *Doctrine for the Armed Forces of the United States. Joint Publication 1.* Washington D.C.: Joint Chiefs of Staff, July 12, 2017.

Wright, Quincy. *A Study of War*. Abridged by Leonard Wright, Louise. Chicago: The University of Chicago Press, 1983.

East India Company

Bowen, H. V. *The Business of Empire: The East India Company and Imperial Britain, 1756-1833.* New York: Cambridge University Press, 2006.

Marston, Daniel P, ed. and Sundaram, Chandar S. *A Military History of India and South Asia: From the East India Company to the Nuclear Era.* Bloomington, IN: Indiana University Press, 2007.

Robins, Nick. *The Corporation that Changed the World: How the East India Company Shaped the Modern Multinational*. London: Pluto Press, 2006.

Rommelse, Gijs. "The Role of Mercantilism in Anglo-Dutch Political Relations, 1650-74." *The Economic History Review* 63, no. 3 (2010): 591-611.

Wilson, C.H. *Profit and Power. A Study of England and the Dutch Wars.* Cambridge, 1978.

U.S. Opens the West

Ambrose, Stephen E. *Undaunted Courage: Meriwether Lewis, Thomas Jefferson, and the Opening of the American West*. New York: Simon & Schuster, 1996.

Cozzens, Peter. *The Earth is Weeping: The Epic Story of the Indian Wars for the American West*. New York: Alfred A. Knopf, 2016.

Nunnally, Michael L. *American Indian Wars: A Chronology of Confrontations Between Native Peoples and Settlers and the United States Military, 1500s-1901*. Jefferson NC: McFarland & Company, Inc., 2007.

Bradley, Ed. *"We Never Retreat": Filibustering Expeditions into Spanish Texas, 1812-1822.* College Station: Texas A&M University Press, 2015.

China in Africa

Brown, David E. *Africa's Booming Oil and Natural Gas Exploration and Production: National Security Implications of the United States and China*. Carlisle Barracks PA: United States Army War College Press, 2013.

Chau, Donovan C. *Exploiting Africa: The Influence of Maoist China in Algeria, Ghana, and Tanzania.* Annapolis MD: Naval Institute Press, 2014.

Herman, Fanie. *China's African Peacekeeping Decision-Making in Hu Jintao's Era.* Delhi: Vij Books India Pvt Ltd, 2015.

Nolan, Peter. *Is China Buying the World?* Malden, MA: Polity Press, 2012.

Reed, Lucy and Wong, Kenneth. "Marine Entitlements in the South China Sea: The Arbitration Between the Philippines and China." *The American Journal of International Law* 110. no. 4 (October 2016), 746-787.

Taylor, Ian. *China's New Role in Africa*. Boulder, CO: Lynne Rienner Publishers Inc., 2009.

Waldron Arthur, ed. *China in Africa: A Compendium of Articles from The Jamestown Foundation's China Brief.* Washington D.C.: The Jamestown Foundation, 2009.

Warner, Gregory and Langfitt, Frank. "China Breaks New Ground on Military Base in Africa." Npr.org, April 18, 2016. https://www.npr.org/2016/04/18/474639376/china-breaks-ground-on-military-base-in-africa (accessed February 15, 2018).

Wuthnow, Joel. *Chinese Perspectives on the Belt and Road Initiative: Strategic Rationales, Risks, and Implications*. Washington D.C.: National Defense University Press, 2017.

Space

Cordesman, Anthony H. with Kendall, Joseph. *Chinese Strategy and Military Modernization: A Comparative Analysis*. Center for Strategic & International Studies, 2017. https://csis-prod.s3.amazonaws.com/s3fs-public/publication/170112_Chinese_Strategy_and_Military_Modernization.pdf?Ikd72h18mXYw.mcTydjM5ljuu7cjk2AL (last accessed April 9, 2018).

Crane, Leah. "Elon Musk's New Plans for a Moon Base and a Mars Mission by 2022." Newscientist.com, September 29, 2017. https://www.newscientist.com/article/2149003-elon-musks-new-plans-for-a-moon-base-and-a-mars-mission-by-2022/ (accessed October 25, 2017).

Cofield, Calla. "Feasible or Fantasy? SpaceX's Mars Plan Draws Expert Reactions." space.com, September 29, 2016. https://www.space.com/34235-spacex-mars-plans-feasible-or-fantasy.html (accessed February 15, 2018).

Colloredo, Lisa. "Commercial Crew Program (CCP): NASA Advisory Council HEOMD Committee Status." National Aeronautics and Space Administration, November 29, 2017. https://www.nasa.gov/sites/default/files/atoms/files/nac_ccp_status_nov_29_2017-2.pdf (accessed February 15, 2018).

Deep Space Industries, Inc. "Mining." Deep Space Industries, Inc. https://deepspaceindustries.com/mining/ (accessed February 15, 2018).

Dempsey, Paul Stephen. "National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement." *Northwestern Journal of International Law & Business* 36. no. 2 (Winter 2016): 1-44.

Deptula, David A., Watts, Barry D., and Cheng, Dean. "Panel V Air and Space Forces" *William B. Ruger Chair of National Security Economics Papers, Number 3. Defense Strategy and Forces: Setting Future Directions*. edited by Richard M. Lloyd, 187-238. Newport RI: Naval War College, 2008.

Dolman, Everitt C. *Astropolitik: Classical Geopolitics in the Space Age.* New York: FRANK CASS PUBLISHERS, 2002.

Drake, Nadia. "Elon Musk: Million Humans Could Live on Mars By the 2060s." news.nationalgeographic.com, September 27, 2016. https://news.nationalgeographic.com/2016/09/elon-musk-spacex-exploring-mars-planets-space-science/ (accessed February 15, 2018).

Dunbar, Brian. "NASA Extends Expandable Habitat's Time on the International Space Station." National Aeronautics and Space Administration. https://www.nasa.gov/feature/nasa-extends-beam-s-time-on-the-international-space-station (accessed February 15, 2018).

Edwards, Jim. "Goldman Sachs: Space-Mining for Platinum Is 'More realistic than perceived.'" Businessinsider.com, April 6, 2017. http://www.businessinsider.com/goldman-sachs-space-mining-asteroid-platinum-2017-4 (accessed February 15, 2018).

Gibson Dirk ed. *Commercial Space Tourism: Impediments to Industrial Development and Strategic Communication.* SAIF Zone: Bentham Science Publishers, 2012.

Githens, Dawn M. *Overcoming the Illusion of Security: Creating a New Spacefaring Security Strategy Paradigm*. Master's Thesis. Norfolk, VA: Joint Advanced Warfighting School, 2014.

Hampton, Jesse. "Space Technology Trends and Implications for National Security." *Kennedy School Review* 15. (2015): 12-16.

Hayes, Tracey L. *Proposal for a Cooperative Space Strategy with China*. Master's Thesis. Norfolk, VA: Joint Advanced Warfighting School, 2009.

Hayward, Keith. *British Military Space Programmes*. London, UK: Royal United Services Institute, 1996.

Hendrix, Jerry and Routh, Adam. *A Space Policy for the Trump Administration*. CNAS. October 2017. https://s3.amazonaws.com/files.cnas.org/documents/CNASReport-SpacePolicy-Final5.pdf?mtime=20171023151800 (last accessed April 9, 2018).

Johnson-Freese, Joan. *Space as a Strategic Asset.* New York: Columbia University Press, 2007.

_____. *Space Warfare in the 21st Century: Arming the Heavens*. London, UK: Routledge, 2017.

Klein, John J. *Space Warfare: Strategy Principles and Policy*. Hoboken, NJ: Taylor and Francis 2012.

McCoy, Keegan S. "Book Review: Developing National Power in Space: A Theoretical Model." *Air & Space Power Journal* 30. no.4 (Winter 2016): 109-111.

Morris, Alison. "Intergalactic Property Law: A New Regime for a New Age." *Vanderbilt Journal of Entertainment & Technology Law* 19. no. 4 (Summer 2017):1085-1114.

Moltz, James Clay. *Crowded Orbits: Conflict and Cooperation in Space*. New York: Columbia University Press, 2014.

Planetary Resources. "Arkyd-3R." Planetary Resources. https://www.planetaryresources.com/missions/a3r/ (accessed February 15, 2018).

_____. "Arkyd-301." Planetary Resources. https://www.planetaryresources.com/missions/arkyd-301/ (accessed February 15, 2018).

Pollpeter, Kevin. *Building for the Future: China's Progress in Space Technology During the Tenth 5-Year Plan and the U.S. Response*. Carlisle Barracks PA: Strategic Studies Institute, 2008.

Pollpeter, Kevin and Ray, Jonathon. "Chapter 8. The Conceptual Evolution of China's Military Space Operations and Strategy" In *China's Evolving Military Strategy*, edited by Joe McReynolds, 241-278. Washington, DC: The Jamestown Foundation, 2016.

Robertson, Ann E. *Militarization of Space*. New York: Infobase Publishing, 2011.

Sadeh Eligar. *Space Strategy in the 21st Century: Theory and Policy*. London: Routledge, 2013.

Seedhouse, Erik. *SpaceX: Making Commercial Spaceflight a Reality*. New York: Springer Science and Business Media, 2013.

Seligman, Lara. "The Fight for Space." *Aviation Week & Space Technology*. (06 March 2017): 17.

Sheetz, Michael. "Air Force General says China is Advancing in Space Five Times as Fast as the US." cnbc.com, November 13, 2017. https://www.cnbc.com/2017/11/10/usaf-general-steve-kwast-china-in-space-five-times-faster-than-us.html?recirc=taboolainternal (accessed February 16, 2018).

Smith, M.V. "Spacepower and the Strategist" *Strategy: Context and Adaptation from Archidamus to Airpower*. edited by Richard J. Bailey Jr., James W. Forsyth Jr., and Mark O. Yeisley, 157-185. Annapolis MD: U.S Naval Institute, 2016.

Space Exploration Technologies Corp. "Missions to Mars." Space Exploration Technologies Corp. http://www.spacex.com/mars (accessed February 15, 2018).

Sykes, J. P., Wright, J. P. and Trench, A. "Discovery, Supply and Demand: From Metals of Antiquity to Critical Metals," *Applied Earth Science* 125. no. 1 (2016): 3-20. http://www.tandfonline.com/doi/full/10.1080/03717453.2015.1122274 (accessed February 15, 2018).

UN General Assembly, Thirty-Fourth Session, Official Records, Supplement 46. *Resolution 34/68: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*. New York: UN, 1980. http://www.un.org/ga/search/view_doc.asp?symbol=a/34/46(supp) (accessed January 2, 2018).

United Nations Office for Outer Space Affairs. "Roles and Responsibilities." United Nations Office for Outer Space Affairs. www.unoosa.org/oosa/en/aboutus/roles-responsibilities.html (accessed April 4, 2018).

U.S. Department of State. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*. Washington, DC.: US Government Printing Office, October 10, 1967, Available at https://www.state.gov/t/isn/5181.htm (accessed February 17, 2018).

United States USAF Scientific Advisory Board. *New World Vistas Air and Space Power for the 21st Century: Space Applications Volume*. Washington, DC.: Federal Information Exchange, Inc., 1996.

_____. *New World Vistas Air and Space Power for the 21st Century: Space Technology Volume*. Washington, DC.: Federal Information Exchange, Inc., 1996.

U.S. Congress. *An Act To amend title 49, United States Code, to include consideration of certain impacts on commercial space launch and reentry activities in a navigable airspace analysis, and for other purposes.* Public Law 248. 114th Cong., 2nd Sess.

(November 28, 2016). https://congress.gov/114/plaws/publ248/PLAW-114publ248.pdf (accessed December 30, 2017).

_____. House. Committee on Armed Services. *Assuring Assured Access to Space: Hearing before the Subcommittee on Strategic Forces*. 114th Cong., 1st Sess., March 17, 2015. https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg94223/pdf/CHRG-114hhrg94223.pdf (accessed December 29, 2017).

_____. Senate. Committee on Armed Services. *Assured Access to Space: Joint Hearing before the Subcommittee on Strategic Forces and Committee on Commerce, Science, and Transportation.* 113th Cong., 2nd Sess., July 16, 2014. https://www.gpo.gov/fdsys/pkg/CHRG-113shrg93719/pdf/CHRG-113shrg93719.pdf (accessed December 29, 2017).

_____. *National Aeronautics and Space Administration Transition Authorization Act of 2017*, Public Law 10. 115th Cong., 1st Sess. (March 21, 2017). https://www.congress.gov/115/plaws/publ10/PLAW-115publ10.pdf (last accessed April 9, 2018).

_____. *U.S. Commercial Space Launch Competitiveness Act*, Public Law 90. 114th Cong., 1st Sess. (November 25, 2015). https://congress.gov/114/plaws/publ90/PLAW-114publ90.pdf (accessed December 30, 2017).

Velocci, Jr. Anthony L. "Commercialization in Space." *Harvard International Review* 33. No. 4 (Spring 2012): 49-53.

Wall, Mike. "SpaceX Launches (and Lands) Used Rocket on Historic NASA Cargo Mission." space.com, December 15, 2017. https://www.space.com/39063-spacex-launches-used-rocket-dragon-spacecraft-for-nasa.html (accessed February 15, 2018).

Weeks, Edythe. Outer Space Development, International Relations and Space Law: A Method for Elucidating Seeds. Newcastle-upon-Tyne: Cambridge Scholars Publishing, 2012.

Williams, Matt. "How Long Does It Take to get to the Moon?" universitytoday.com, May 12, 2016. https://www.universetoday.com/13562/how-long-does-it-take-to-get-to-the-moon/ (accessed February 15, 2018).

Zhao, Yun. *National Space Law in China: An Overview of the Current Situation and Outlook for the Future*. Leiden, Netherlands: Printforce, 2016.

Ziarnick, Brent. *Developing National Power in Space: A Theoretical Model*. Jefferson, NC: McFarland & Company Inc., 2015.

Vita – Wing Commander Daniel A. Penter – Royal Air Force

Wing Commander Dan Penter (UK) commissioned into the Royal Air Force in 1998 following sponsorship through the graduate entry program at the University of Bristol. As an Engineering (AeroSystems) Officer, Penter has commanded Engineering Flights and Squadrons covering support to, or direct maintenance of, Tornado F3, Tornado GR4, Chinook, Apache, and Lynx. He has served in Afghanistan as a Squadron Engineering Officer and on Expeditionary Air Wings in a variety of locations supporting operations in Iraq, Afghanistan, and Syria between 2000 and 2015; most recently he was the Chief of Staff (Support) at Number 83 Expeditionary Air Wing at Al Udeid Air Base, Qatar. Penter has led two major Lean change programs applying process improvement techniques on base, on operations, and in two procurement programs. He has worked in London firstly as the military assistant to the UK MOD's 2-star lead for Nuclear and Chemical Biological policy, and subsequently providing support to the Royal Saudi Air Force Tornado fleet. Penter has multinational procurement experience working on the F-35 Program, firstly in the UK as the Training Systems lead, and most recently in Logistics and Sustainment at the Joint Strike Fighter Program Office in Arlington, VA. Wing Commander Penter holds a Master of Engineering Degree in Aeronautical Engineering and is Chartered Professional Engineer with the Institute of Mechanical Engineering.