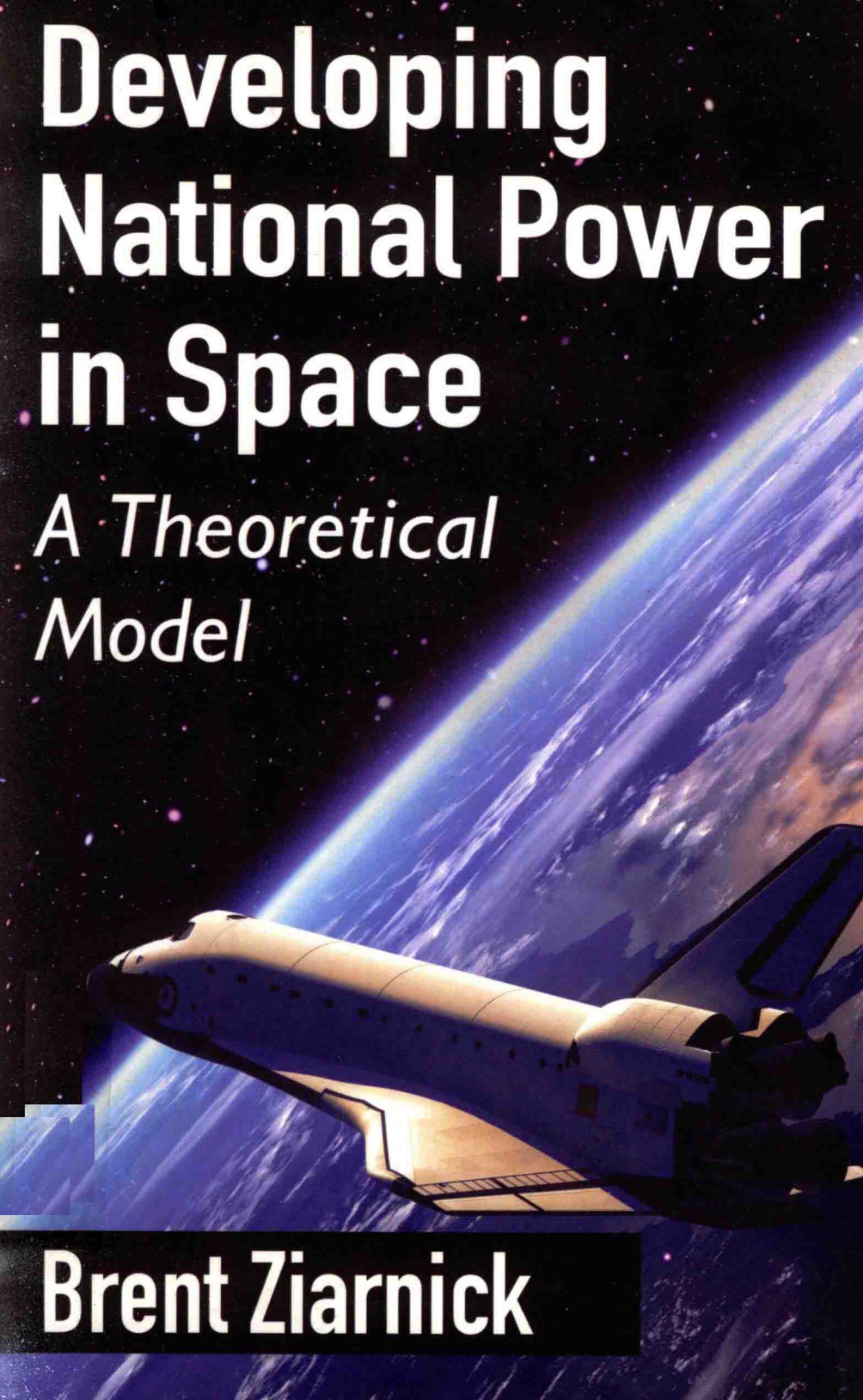
Developing National Power in Space

A Theoretical Model



Brent Ziarnick

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Developing National Power in Space

For my wife, Melissa, and my children Ashley, David and Christopher.
May this book help you live in a safer and more prosperous future.
To the officers and men of the American military space
forces past, present, and future. *Ad Astra!*

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Introduction: The Eclipse of American Space Power?

Man has always known space. From our first ancestor humanity has been able to see the stars and the black void which holds them, simply by looking up. However, only in the last hundred years has mankind been able to harness the power of creation well enough to travel to the heavens. The launch of *Sputnik* on 4 October 1957 forever changed the relationship between space and man. Instead of simply being a source of inspiration, wonder, knowledge, or fear, space became a place where men and his machines can go—a *human environment*. Space travel in the early 21st century is still dangerous, difficult, and expensive, but it is accessible just as man can travel through the air or on and beneath the sea. Man can now *use* space for his own purposes. Man has begun to expand his dominion into space and bring this hostile environment under his control. Man can now build space power.

And at the beginning of the 21st century, the nation that has best harnessed space for its own purposes is the United States. Americans have been the only people to set foot upon another world. Almost every American life is exposed to space services on a daily basis. Drivers reach their destinations through navigation provided by satellite navigation through the Global Positioning System. Weather forecasts are generated using weather satellite data and transmitted to the public through satellite communications. New photos from space telescopes or unmanned probes are constantly posted on the internet and consumed by schoolchildren and the interested public. At any time of the day, basic cable television will undoubtedly be playing a broadcast highlighting space, either a nonfiction history or science program or—more likely—a science fiction adventure. No other society on Earth is as exposed to space as is the United States. No other nation can come close to the amount

of wealth and power derived from space as the American nation. But today, many Americans look to the stars unsettled, fearing that they may soon be eclipsed in space by a foreign competitor.

The Paradox

United States space activity, by any measure, is far and away the most advanced and largest program in the world, but there is a growing belief that America has lost its leadership in space to China. Thus the paradox of space power in the early 21st century: The most dominant space power in the world is in crippling fear of being dethroned by a program far smaller. In some metrics, it does appear that Chinese activity is beginning to outpace America's. According to the Space Foundation's *The Space Report 2013:*

> In 2012, China continued to outpace the United States in the number of orbital launches, making 19 orbital launch attempts in 2012, all of which were successful. This makes 2012 the second consecutive year in which China has surpassed the United States as the world's second most active launch operator, due primarily to China's accelerating progress in deploying new scientific and communications satellites, and continued deployment of its Beidou satellite navigation constellation. China's 2012 activity also included its fourth crewed mission, Shenzhou 9, which launched on a Long March 2F in June 2012. Chinese officials have stated that they plan to maintain a launch rate of up to 20 missions a year for the foreseeable future. If China reaches this state, it may pull further ahead of the United States, which has conducted an average of 18 launches per year during the past five years.[1]

Orbital rocket launches are perhaps the most visible and spectacular manifestations of a nation's space activity and it is no surprise that some consider China overtaking the United States in number of annual space launches indicates taking the lead in space. However, we must remember that the world's launch leader for many years has not been the United States, but Russia. Of course, the reasons the Russians launch so many rockets is because they are both a low-cost launch services exporter that deals with many commercial payloads from around the world, and that their national security satellite systems are designed with relatively short service lives, necessitating multiple launches to produce the same level of general service that American systems can accomplish with a single satellite over a decade or longer. The Chinese space program is growing, but simple greater launch rates do not a space leader make.

Even if launch rates don't justify a declaration of a China lead in space, certainly their human spaceflight program merits special consideration. Again, *The Space Report* states the facts:

> The fourth Chinese human spaceflight mission, Shenzhou 9, took place in June 2012, achieving several new milestones for China. The primary goal of the Shenzhou 9 mission was to dock with the Tiangong-1 space station, a technology testbed and the first in a series of similar space stations of increasing complexity, designed to eventually lead to a larger, more permanent, modular Chinese space station. While China had conducted automated docking procedures between Tiangong–1 and the unmanned Shenzhou 8 mission in 2011, Shenzhou 9 was the first manually controlled docking operation for China.... So far, China has used each of its four crewed flights to develop its capabilities and to test procedures, in a manner reminiscent of the U.S. Gemini program. This pattern is expected to continue for the foreseeable future.[2]

Alternatively, the report says of the American space program:

> The United States, after the Soviet Union, was the second nation to send a human into space, but it will not have its own human spaceflight capability for the next several years, following the retirement of the Space Shuttle in 2012.[3]

The rapid ascent of the Chinese manned spaceflight program, coupled with the retirement of the American space shuttle, has made a large gap between Chinese and American space capabilities appear to be a grim and undeniable reality. This perceived gap has led some to issue dire pronouncements for American space policy. One former U.S. State Department official claims the "atrophying U.S. space program suggests that America will be forced to cooperate or cede the high frontier of space to China forever."[4] One Naval War College professor calls cooperation essential because "[i]t's one way of preventing a scenario of a galactic Wild West in which China has become the world's leader in space."[5] Even some who don't want the United States to cooperate with China in space and advocate competing against them as adversaries are nonetheless in awe of China's apparent lead. Hotel billionaire and American space entrepreneur Robert Bigelow has stated that the United States cannot contest an inevitable Chinese takeover of the Moon and the only way to defeat China in space is to concede the Moon but beat them to Mars![6]

Chinese-American space cooperation may or may not be a worthwhile goal, but approaching cooperation in supplication from a perceived position of weakness, as a fear of Chinese space ascendancy would entail, would probably be detrimental to American interests. But is China really eclipsing the United States in space? Author Erik Seedhouse argues:

> Thanks to its high-profile manned space missions, much of the world perceives China as catching up with the space capabilities of the U.S. In reality, nothing could be further from the truth but, as China continues to accelerate its manned space program, the two nations may eventually approach a critical juncture that will decide whether the U.S. will be considered as the leader in human spaceflight. However, it is highly unlikely the U.S. will abrogate its leadership role in human space-

> flight, since this would have strategic consequences beyond the space realm. Equally, the Chinese, bolstered by the media coverage of their successful manned missions, will be determined to maintain their sustained effort and to see their goal of leadership in space through to a successful conclusion.[7]

So which is it? Has China overtaken the United States as the world's presumed space leader? Must the United States be forced to cooperate with China or risk being swept from the stars altogether? Or is the United States still the undisputed master of space power?

This paradox exists because two different measures of comparative space activity tell two very different stories about China and the United States. The first measure, the absolute value (in dollars) of the size of each country's cumulative space program, clearly shows an American space program an order of magnitude larger than China's. However, the annual rate of growth of each program—the second measure—describes a relatively stagnant American space program compared with a Chinese program expanding at an alarming rate. Futron Corporation's annual Space Competitiveness Index offers a great tool with which to evaluate both the absolute size and rate of growth of America's and China's space programs. Futron describes the index:

> Futron's Space Competitiveness Index is a globally-focused analytic framework that defines, measures, and ranks national competitiveness in the development, implementation, and execution of space activity. By analyzing space-related government, human capital, and economic drivers, the SCI framework assesses the ability of a country to undertake space activity, and evaluates its performance relative to peer nations, as well as the global space arena.[8]

Futron's proprietary model attempts to account for both absolute values and rates of change for each nation's space program, but it does allow for direct comparisons. Comparing both countries through Futron's index, the United States received a score of 91.36 and China received a score of 25.65 on a scale of 0–100. According to the SCI, the United States is clearly dominant. However, Futron explains that this isn't the entire story:

> In the 2009, 2010, 2011, and 2012 SCI results, the United States saw a steady erosion of its position in relation to the other nine countries surveyed. The United States experienced a 4 percent decline in its overall score between 2008, when SCI benchmarking began, and 2012.... China has shown the most impressive gains of any nation, with a 41 percent increase relative to its 2008 starting score.[9]

The United States is dominant, but the SCI also shows that the American program is in a measure of decline, while China program is the fastest-improving space program in the world. Futron assessed China's program favorably for many reasons:

> China placed 4th for the second year in a row in the Space Competitiveness Index, solidly ahead of Japan but below Russia. China enjoyed the most pronounced relative competitiveness gains of any nation in the 2012 SCI. Only four nations advanced their relative positions over the previous year. China led these countries, with an average competitiveness increase of 2.52 basis points. In addition, China improved its score relative to every other nation in the study. This was primarily driven by the continued success of its launch industry, advancements in its satellite navigation and manned space programs, and new policy pronouncements unveiling its space activity plans over the next five years.[10]

Alternatively, the United States has the most advanced program in existence, but the rest of the world is catching up.

> As in previous editions of Futron's Space Competitiveness Index (SCI), the United States remained the highest-ranked country in the 2012 SCI, with a total score of 91.36. However, the gap between the United States and other nations continues to shrink as other nations enhanced their capabilities relative to the United States.... Key factors accounting for changes in the U.S. score included:
>
> - Decline in the ranking of the U.S. in number of annual launches performed, from second place to third, behind China; and
> - General expansion of the space activities of most other nations compared to the United States
>
> The countries that made the greatest advancements against U.S. positioning included China, which gained three basis points.... While the U.S. position as the leading spacefaring nation has gradually eroded, the gap between it and other nations remains large: its overall lead over second-place Europe is more than 40 basis points, and its lead over third-place Russia is more than 50 basis points.[11]

Thus, the American space program is strong but it is losing ground to other countries. The American program's rate of change is relatively stagnant, and may even be contracting. The answer to the paradox, then, is that the American program is large and dominant but the rate of change indicates that it is at risk of not being dominant for much longer, causing fear that the "growth giant" of China will become the leader in space in short order.

A Theory of Space Power Development

Ensuring the dominance of the American space program for years to come boils down to just one thing—causing the rate of change in the value of the U.S. space program to improve until it matches or exceeds that of its world space competitors. Simply achieving even a marginally close approximation to the change rate of competitors such as China will be enough to insure U.S. space mastery for years to come by virtue of America's current commanding lead. But growth alone is simply not enough; any space program must increase

its technological capabilities in order to develop. As economist Joseph Schumpeter said, "Add successively as many mail coaches as you please, you will never get a railway thereby."[12] Likewise, launch as many microsatellites as you please, you will never get a manned interstellar starship thereby. In order to add true value, in space power as in economics, growth by itself pales in relation to positive development, and positive development is achieved through innovation.

This book is about developing space power. It will present a theoretical model describing how space power is developed and describe what strategies can be implemented to help foster the development of a nation's space power. The theory is based on classical military and economic theories, and supporting chapters derive their historical and strategic lessons often from military history. Therefore, the ideas presented in this book may be far different than what average space enthusiasts read about space. Alternatively, military readers may be jarred to find references to interstellar flight and other "futuristic" ideas analyzed using methods normally reserved for conventional military affairs. The author hopes that by opening new vistas to many communities, a better synthesis of these communities may arise to champion the development of space power.

Lastly, since this book is an attempt to write a serious military-type strategic theory for a nation's space program, it must adhere to the needs of military theory. Navy Admiral J.C. Wylie stressed what theory should do:

> A theory in any such field as that of strategy is not itself something real and tangible; it is not something that actually has concrete existence. A theory is simply an idea designed to account for actuality or what the theorist thinks will come to pass as actuality. It is orderly rationalization of real or presumed patterns of events. A basic measure of validity of any theory is how closely the postulates of the theory coincide with reality in any actual situation. If any military theory has any proven validity, it is because some practicing military man has actually given it that validity in a real situation. The theory serves a useful purpose to the extent that it can collect and organize the experiences and ideas of other men, sort out which of them may have a valid transfer value to a new and different situation, and help the practitioner to enlarge his vision in an orderly, manageable, and useful fashion—and then apply it to the reality with which he is faced.[13]

Admiral Wylie sets the demands on a successful theory. Professor Harold Winton argues that successful theories must accomplish five functions. First, the theory must "define the field of study under investigation." Second, the theory must "categorize—to break the field of study into its constituent parts."[14] Third, and most importantly, the theory must explain its subject. The theory must be able to explain why things happen the way they do. To Winton, "explanation is the soul of theory." Fourth, the theory must connect the field of study to "other related fields in the universe." Lastly, theory must anticipate.[15]

It must reasonably predict future results given a solid understanding of the present facts of an endeavor involving the field of study.

The space power theory described in Chapter 1 will endeavor to meet all of Dr. Winton's requirements. We will define space power and compare this historically derived definition to other definitions offered in the past. We will then break our subject down into its constituent parts: the Logic and Grammar of Space Power and the elements which comprise both parts. Next, the theory will explain how certain activities can generate space power and how space power is developed. Finally, the chapter will connect this space power theory to other fields of study: in this case primarily economic theory, military theory, and political science, and general strategy, in order to show that space power is a human endeavor and answerable to human behavior.

The next four chapters will tackle Winton's final function of theory—anticipation. Chapter 2 will investigate the Grammar of Space Power and develop explanatory tools and concepts that the theory anticipates will increase an agent's space power if employed. Chapter 3 will turn to the Logic of Space Power and anticipate organizational actions that can increase the space power of a nation. Chapter 4 will present a historical example from the U.S. Navy and its approach to sea power development from the 1880s to the end of World War II's Pacific War to showcase the concepts behind this space power model in action. Finally, Chapter 5 will apply the theory to anticipate which technologies and which organizational changes would most benefit an American space force in dealing with a number of potential space power challenges in the middle of this century.

The theory and ideas presented in this book cannot be used and are not intended to be used as a cookbook aiming to explain to space power professionals, policy makers, and other space leaders exactly what to do in any given situation. Rather, this book is intended to fulfill what Winton hoped a mature space power theory could do: to assist in the self-education of space leaders and identify the explanatory relationships that guide the use and development of effective space power as best as it is able.[16] If this book, in some small part, assists in the positive development of the next generation of American space leaders then it will have served its purpose. Perhaps these leaders may even drive American space power development to levels that are the envy of the world ... even the Chinese.

Chapter 1

The General Theory of Space Power

This chapter outlines a General Theory of Space Power. It is the *general* theory because it intends to describe all space activity for whatever purpose in whatever era. This is in contrast to other space power theories which have tended to focus on *specific* applications of space activity, such as military space operations. By describing space power in its broadest form, the general theory can be applied to any type of space activity, real or imagined. The General Theory demonstrates a complete view of space activity to allow the reader opportunity to see the many elements involved in space power.

The Intent of the General Theory

The General Theory of Space Power intends to accomplish multiple objectives. Space power theory is still a relatively new field and, as yet, most models offered have been incomplete in a number of ways. Some have been driven entirely by recent technology and operations; others have been entirely devoted to military modes of operation. This space power model, an adaptation of Admiral Alfred Thayer Mahan's and economist Joseph Schumpeter's ideas (among others), is offered as an attempt to correct some of these mistakes and expand the analysis to include past, present and future space activities. Specifically, the model intends to accomplish the following objectives:

1. *The General Theory intends to be comprehensive across activity.* The General Theory intends to understand space power and its development in its totality, and consequently must be applicable across all forms of space activity: commercial, civil, political, and military. It

does not focus on any one specific activity and does not unduly prefer military activity. The model is intended to be a key tool for military space planners, but should be equally useful to political and economic space interests. It is able to assess military projects like space-based radars and commercial efforts such as space tourism on an even level and offer guidance on what space endeavors should be promoted by governments to improve the nation's space power. Like Mahan's sea power theory, the General Theory includes all space activities and offers insight into which activities are most valuable for aspiring space powers.

2. *The General Theory intends to be universal across time.* This model is not intended to be limited by technology or time frames past, present or future. Just as Mahan's sea power theory was derived from the Age of Sail but of immediate use in the oil-fueled Pacific War and even today's nuclear age, the General Theory intends to explain actions throughout the duration of the human space effort. Whether used in exploring the Cold War space campaigns, the age of satellites as global utilities, future activities to colonize the Moon, or even interstellar cruisers of science fiction fame, this model is meant to provide a ready and useful framework for analysis.
3. *The General Theory intends to be descriptive.* The General Theory posits the elements of space power and how commercial, political, and military space power interact with each other. Using the General Theory, we can explore space history to find why some space activities succeeded and others failed, and how space powers can rise or fall. Instead of merely mimicking history and assuming success, the General Theory can criticize past actions against a space power ideal. Indeed, the General Theory does not find much to congratulate in history and instead offers that space history is mostly a story of blunders and poor actions as leaders embraced one or more mistakes in making space policy.
4. *The General Theory intends to be prescriptive.* The General Theory offers specific advice on what space powers must do to gain, develop, and keep space power. Thus, the General Theory intends to inform policy makers and provide them with advice to build better strategies and space policies focused on space power growth. It offers an ideal approach, as well as a discussion and analysis framework from which to judge various courses of action. The author believes the space powers that follow the prescriptive advice of the General Theory will

emerge as viable and effective space powers and help lead their people to both security and prosperity through space activity.

5. *The General Theory intends to bridge the gap between military realism and enthusiast futurism.* Sea and air power have always had military officers who were also enthusiasts for developing their environment. Though sea power's beginnings are lost in antiquity, we know that air officers were among the first to call for exotic equipment thought of as science fiction in their day—consider Billy Mitchell's visions of supersonic, high altitude, heavy bombers. Space power does not currently enjoy this continuity. Promotion of lunar bases and manned spaceflight usually come from the National Aeronautics and Space Administration (NASA), not Air Force Space Command. Space enthusiasts dream of living in space, while military space officers are focused on cold short-term realities. In order to grow space power, space officers need to become space enthusiasts, and enthusiasts need to adopt military terminology to better work together to promote their common interests in space development. The General Theory, combining both views into a single continuum, may help begin an essential dialogue.

The General Theory is not a model that pretends to account for every interaction among its constituent parts (i.e., a systems dynamics model) nor does it claim mathematical precision. It is meant only as a qualitative and top-level model that can provide policy makers, strategists, and analysts a visual representation of high-level operations and relationships. Numerous feedback loops occur among all of the model's parts at some level. Also, there is no linear progression between the Grammar and Logic deltas (its two main component parts), but a continuous ebb and flow of multiple technologies and doctrines. Regardless, a linear flow model such as the General Theory sufficiently contains the essence of space power development and is effective as an analysis tool.

The General Theory strives to be of more than simple academic interest. It is meant to be used by policy makers and strategists, enthusiasts and businessmen, and space realists, to help develop and test the validity of their proposed space activities. No model can be perfect or complete without years of debate, study, and peer review, and this General Theory is neither perfect nor complete. As strategist Colin Gray says, "A powerful explanatory tool, which is what good theory should be, need not be capable of explaining everything" in order to be useful.[1]

However, it is hoped that this introduction will serve as a firm base with which to plan and analyze humanity's conquest of the space environment for peace, prosperity, and security.