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Letter from the Editor

We are very excited to present our new and updated Summer 2021 issue of Space and Defense. We are sure readers will notice a significant difference with and proceeding issues. Over the last few years, our editorial team has been implementing important changes to this journal. First, we teamed with the University of Nebraska at Omaha (UNO) to diversify our readership to include academic institutions in order to attract a broader audience of readers and authors. By teaming with UNO, we have transferred our delivery of the journal onto a digital platform, aiming to increase our readership delivery and accessibility. Secondly, we have widened our aperture to include more topics and research on security studies; specifically, we welcome all topics of security studies, especially deterrence, international relations, and security policy evaluation. Third, we have invited additional experts to our editorial team who represent that security field as it should be and does not exclude in terms of gender or ethnicity. I want to be clear that Space and Defense has never intentionally excluded experts based on these criteria, but as a board we are making a conscious effort to expand our field of experts to be more inclusive and represent the field. We would like to send a warm welcome to those who have recently joined our editorial board, and we look forward to inviting more experts as we continue to grow as a journal. Finally, we would like to introduce our new branding efforts that re-images the journal and present the integration of the Air Force Academy with UNO, which is the first joint military and academic journal of its kind. Our re-branding efforts include a new cover page, new style format, and a digital platform. We hope that our efforts over these past few years prove our commitment to providing the community with innovative research for a broader audience that enhances the security field. We hope you enjoy our Summer 2021 issue of Space and Defense: Innovative Research in Security Studies.

Michelle Black, Ph.D.

Russian Development of New Hypersonic Weapons: Drivers and Implications

Julia L. Diamond

The Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START)[1] is, at the time of writing, nearing its 5 February, 2021 expiration date. Both the U.S. and Russia have suspended their obligations under the Intermediate-Range Nuclear Forces (INF) Treaty.[2] A renewal of New START would be the most logical future step that aids the cause of arms control. This is the option that requires the least political will and therefore might suit the current political climate. Nevertheless, the political relationship between the two countries could derail a renewal of New START. Without this renewal, one could ask whether this would truly be "the end of history for nuclear arms control."[3]

If another major bilateral U.S.-Russia or plurital arms control agreement were concluded, it would likely necessitate inclusion of new types of hypersonic weapons, such as the hypersonic glide vehicle (HGV).[4] Russian leaders have said that Russia remains open to extending New START, as well as to meeting the U.S. at the negotiation table should the U.S. initiate further talks regarding the INF Treaty.[5] In order to assess the position from which Russia would come to the table to negotiate limits to strategic nuclear-armed or shorter-range, non-nuclear precision-strike weapons systems, including hypersonic ones, under some sort of arms control mechanism, it would be helpful to uncover the main motivating driver(s) behind the development of Russia's hypersonic weapons systems. Applying models of strategic modernization decision-making can help organize and classify these motivations. This will lead to the conclusions that 1) these new weapons systems have uses that are vital to Russian military strategy, and their development is also likely part of a reaction to external stimuli; and 2) this, combined with the very fact of their development and deployment, gives Russia a position of strength from which to approach any new agreement.

During the second half of the 20th century, scholars applied a number of such models of decision-making to the processes by which the government of the Soviet Union determined on the one hand "weapons acquisition and force structuring" and on the other "military deployments and the use of Soviet military forces."[6] In his chapter "Soviet National Security Decisionmaking: What Do We Know and What Do We Understand?" the late Stephen Meyer organized the literature into summaries of the various general models of decision-making in existence.[7] Scholars have also tried to apply models to Russian defense decision-making. In a more recent book, *Russian Strategic Modernization: Past and Future*, Nikolai Sokov applies the models he believes were most relevant to the Soviet and Russian strategic

modernization process.[8]

Meyer provides an overview of the action-reaction model with its variant, the technological dynamic model, the military superiority model, interest-group models (the bureaucratic politics model and various applications of interest group models under this title), national leadership model, and the military mission model.[9] He argues that the literature existing at that time was often more descriptive than analytical, did not consider all data available, and often did not include tests of a given model against time in the form of follow-up research. Important to this conclusion and to most modeling works is the basic premise that under the conditions of incomplete information "[t]he most desirable model is one that can explain and predict the widest range of behavior with the fewest number of inputs."[10] Predictably, the chapter calls for further intense study.

In what seems to be an answer to Meyer's call, Sokov tests conclusions drawn in the 1970s and 1980s through analysis of the historical record of Soviet decision-making on strategic modernization, START I negotiations, the breakup of the Soviet Union, consolidation of the Russian nuclear arsenal, START II negotiations, and modernization activities after 1991. In his 2000 book, Sokov applies the models he believes best explain the Soviet and early Russian strategic modernization process and joins scholars who attempted to characterize Russian defense decision-making in that realm.

According to Sokov, a combination of external and domestic factors as influencers, and the *bureaucratic model* (like others, he minimizes distinction between this and interest group models for the Soviet and very early Russian cases), the *parity model*, the *action-reaction model*, and the *military mission model* are most applicable to Soviet strategic modernization from the 1960s through the 1980s, as well as early Russian strategic modernization.[11] He shows that these also help to explain Soviet and early Russian decision-making during arms control negotiations.

Differing theories on motivations behind Russian development of new hypersonic weapons and other "exotic" weapons systems have been floated in the public debate and news media in recent years. Pavel Podvig's arguments support the technological dynamic model and an action-reaction model asymmetric approach. He has argued that this development of newer strategic weapons systems is driven by parochial interests of actors in an unimpeded defense industry who lobby for their own projects that "'may not have a clear purpose or strategic mission,'" and that it is also the result of hysteria over the need to counter U.S. missile defenses.[12] Podvig and Alexander Stukalin offer the idea that Russia could use its hypersonic development program "to gain leverage in arms control discussions with the U.S. on the establishment of limits to missile defense and conventional strike capabilities."[13] Alexei Arbatov suggests that weapons like HGVs and other areas of military

expenditure are responses to perceived threats from the U.S. like "first global preemptive strike."[14] The idea that such weapons were developed to evade missile defenses has also been sounded by officials and in the Russian media.[15]

In many cases, more supporting research could be conducted. Testing models in analysis of the modern Russian military defense complex is rare. Re-establishing a record of models applicable to certain historical periods and certain research and development and development programs allows for the classification of these different decision-making cases. While not ensuring foresight, the application of models gives perspective and clarification to what can otherwise be murky procedure and helps provide for a more organized public debate. It also provides a common language with which to compare and contrast current circumstances and observations with those from the past. Understandings that result from such analysis could help both with one's own understanding of an adversary's military doctrine, as well as with thinking about a future for arms control.

This article applies models of decision-making given the facts observed for one historical period – the mid-2000s through the mid-2010s – and one series of development programs – those falling under the title "hypersonic weapons development program." It tests whether some of the models that Sokov argued accurately explain strategic modernization from the late 1960s through the mid-1980s fit Russia's development of its HGV and hypersonic cruise missiles. The action-reaction model, the military mission model, and the bureaucratic interests model are treated as most applicable and are tested against historical and current evidence to judge their utility as analytic lenses. The parity model, by which the Soviet Union sought to achieve numerical parity in warheads on strategic delivery vehicles with the U.S., possibly for negotiation purposes, is not treated as directly applicable to development of new hypersonic systems.[16] However, a revised model with an emphasis on quality could be useful.

The largest amount of high-quality evidence supports the military mission model and elements of the action-reaction model as those which best explain this weapons development. Therefore, it can be deduced that weapons developed under the "hypersonic" umbrella are very likely to be deployed and have missions that directly relate to Russian military doctrine. Assuming political will for arms control revives, the essential role these systems have taken on in deterrence, warfighting, and general power projection will make negotiating their numerical and qualitative limits more difficult than if their development resulted from a technological dynamic. Initially, an overview of the relevant models is necessary.

Models of Soviet and Russian Defense Decision-making

The *action-reaction model* postulates that the state adopts decisions that are in essence reactions to external stimuli "*in an effort to offset and neutralize increased*

threats to Soviet national security."[17] As Meyer summarizes, this means that decisions on weapons design and acquisition, force modernization, and structuring of forces are made in response to such decisions made by other states, especially the U.S. The response actions can include "imitative" (in the words of Russian military officials and experts "symmetric") or "offsetting" ("asymmetric") responses.[18] Underpinnings of what is commonly referred to as the "asymmetric approach" is a concept that, for Russia, has roots in tsarist military strategy and can be found in the writings of Russian military officials today.

According to the *technological dynamic model*, the state that has the technological and economic means to build a given weapons system will build it. This is the result of scientists viewing the given weapons system's development as timely combined with a perceived need to respond to the adversary's weapons acquisition since it "occurs in an action-reaction decision setting."[19] The discourse today reveals that this model remains on the minds of some who watch Russian weapons modernization most closely. However, other than the plethora of new strategic offensive weapons systems coming to fruition, concrete or official evidence supporting this model is scarce.

By the *bureaucratic politics model*, Soviet foreign policy actions were not the result of "black box" decision-making but rather that of the political push and pull of several actors in the Politburo and "heads of several bureaucratic elites at the Central Committee level."[20] The actors in this model are part of the decision-making apparatus. It is assumed that the political system is very bureaucratic, and that there is a collective leadership in which there is no preeminent decision-maker that has the power or wisdom to make decisions alone. Therefore, the actors were assumed to be the members of the Politburo and the agencies that they controlled as both actors and influencers.[21] Whereas the Politburo could be thought of as the top layer of the former, larger decision-making mechanism, today's presidency seems to possess a similar function.[22]

According to *interest-group models*, the actors were envisioned as "interest groups" that seek to influence government decision-making from outside the government.[23] These models have been defined as "the collection of models that posit that *Soviet weapons acquisitions and force structuring are derived from the pulls, pushes, bargaining and compromises that occur as various individual and institutional actors within the Soviet Union compete for resources and power*."[24] The distinction between the bureaucratic and interest-group models in terms of their actors was at times minimized in order to analyze the Soviet decision-making complex. The actors in the Soviet system were all within or so close to the government (the bureaucracy) that they could be considered part of it, rather than existing as influencers external to the bureaucracy, like those found in the U.S.[25] The same can be done in the case of Russia's new hypersonic weapons development decision-making process, where

the actors in and influencers of the process either lie within the federal government or cannot clearly be distinguished from it. Government-owned production companies serve as the best example of this. Therefore, this article focuses on the bureaucratic politics paradigm.[26]

Meyer coined the term *military mission model* when he explained the model of Soviet defense developments by which "*decisions regarding Soviet weapons acquisition and force structuring logically follow from the designation of specific military missions devised by the Soviet military*."[27] The missions are based on "Soviet military doctrine and strategy, institutional histories, organizational self-image and interpretations of the objective nature of the scientific-technical revolution in military affairs (that is, new threats)."[28] The model posits the opposite of the technological dynamic model in that a state that has the technological capability to build a weapon will not necessarily build that weapon.[29] In Sokov's words, according to this model, motivation (mission derived from the military planners), intention (planned strategic force structure), and outcome (final strategic posture) exist in a logical, successive chain.[30]

Relevant Technology

Technology

It is generally accepted around the world that the lower limit of "hypersonic speed" is five times the speed of sound (Mach 5 or 6,174 km/h) or higher. The main types of hypersonic weapons that countries are pursuing today are the HGV (which has also been called a "hypersonic gliding reentry vehicle," a "hypersonic glide delivery vehicle," and a "boost-glide vehicle," and together with its booster – a "boost-glide system"), the terminally guided ballistic missile, and the cruise missile with a scramjet engine. Increased accuracy (a much lower circular error probable) is envisaged to allow for conventional arming of an HGV or terminally guided ballistic missile, assuming the mission provided for this.[31] These weapons are difficult to detect, and especially difficult to intercept with existing missile defense systems. This means that an HGV or a terminally guided ballistic missile would have a mission similar to that of a currently existing ballistic missile but would generally have a larger chance of reaching its target.

As James Acton explains, HGVs are essentially large maneuvering reentry vehicles (MARVs/MaRVS) that are launched or "boosted" by re-purposed ballistic missiles. A given vehicle is then released and proceeds unpowered for perhaps thousands of kilometers, using aerodynamic lift.[32] The glide portion occurs for more than half of the vehicle's flight, which makes it difficult to classify the technology as either a ballistic missile or a cruise missile according to existing arms control treaty text.[33]

The hypersonic long-range cruise missile is another technologically challenging

option. Unlike HGVs, these are powered during flight. Similar to HGVs, they utilize aerodynamic lift. A new engine concept is required in order to make a cruise missile travel at hypersonic speeds. For that purpose, the U.S. has tested rocket-boosted scramjet (Supersonic Combustion RAMjet) engines, which utilize a rocket booster engine to propel the vehicle to an initial high speed.[34] Notably Russia is apparently conducting development work on scramjet engines, as well, and also reportedly tested a cruise missile with a miniature, nuclear-powered engine.

A terminally guided ballistic missile is another more technologically simple option for proceeding with a hypersonic system with increased accuracy and defense penetration capability. These have a steerable reentry vehicle, equipped with a guidance system and flaps that allow for steering toward a target.[35] Arming these with conventional warheads has been noted by some as especially problematic, since a nuclear-armed state could mistake the conventional warhead for a nuclear warhead and retaliate with nuclear means.[36]

HGVs in particular could grant a number of technological advantages to users. They could shorten the time period over which the adversary is aware of the incoming attack. They are also envisaged to more effectively evade existing missile defense systems than traditional ballistic missiles are. This is due to a combination of maintaining hypersonic speed for most of an HGV's trajectory with a flight path of lower atmospheric altitude and less predictability. Current missile defense systems are generally designed to detect, track, and intercept various kinds of traditional ballistic missiles. Terminally guided ballistic missiles might also share some of these advantages.[37]

Russia

Work on Russia's hypersonic systems within the defense industry is conducted under the auspices of the Joint Stock Company "Tactical Missiles Corporation" (KTRV), which is composed of over 30% of Russia's defense enterprises and cooperates with other state and non-state commercial entities.[38] Much as the enterprises that are developing Russia's hypersonic weapons systems are housed under one proverbial roof, the systems themselves were included in a single, two-stage "hypersonic weapons development program" that was pitched to the Russian government's Military-Industrial Commission (MIC) during or soon after 2013 and seems to have been approved by May 2014. The thinking and testing that preceded this began during the Soviet Union and restarted in the early 2000s. A number of enterprises that today specialize in work on different kinds of new hypersonic weapons (those with global reach, tactical sea- and air-based) were added to the KTRV structure at its inception in 2003 or subsequently.[39] The Russian Ministry of Defense is apparently also conducting its own hypersonics research and development work.

The program foresaw the creation of a sub-strategic air-launched cruise missile with

a range of 1,500 kilometers and speed of approximately Mach 6 by 2020. As mentioned above, according to the next stage of the program, a weapon that can travel at up to Mach 12 and has global range is planned. This second system seems to fit the profile of an HGV.[40]

Russia's weapons can be divided roughly into three categories. According to information collected by Podvig and others, the first includes those more relevant to strategic missile defense penetration (though each might support different missions). These include the "Avangard" HGV, and any type of hypersonic warhead that could be fit onto the Sarmat heavy intercontinental ballistic missile (ICBM). The second category encompasses systems that could eventually replace traditional cruise missiles: these are the Tsirkon (3M-22) anti-ship cruise missile (ASCM) with a scramjet engine; new air-launched cruise missiles (ALCMs) such as Kh-90 ALCM work continuation, and possibly the Kinzhal ALCM (though whether it will be hypersonic is questionable). The third category can be reserved for the nuclear-powered, possibly nuclear-armed ALCM, which has questionable speed and is boasted to have "practically limitless" range."[41]

Strategic Weapons

The Avangard HGV, formerly known as the Yu-71 HGV, was worked on within Project 4202. The predecessor program, "Albatross," was initiated in response to the U.S. Strategic Defense Initiative (SDI) in the 1980s.[42] Russia has conducted a number of tests of different vehicles under its predecessor and Project 4202 programs. The first test of an HGV prototype, the Yu-70/102E, is thought to have occurred 28 February, 1990 from the Soviet Union's main ballistic missile and space launch site at Baikonur, (now in Kazakhstan). A second test apparently occurred about a week later, and then, with almost no evidence of further testing throughout the 1990s, the next test occurred on 27 June, 2001, also from Baikonur. Russian President Vladimir Putin was apparently present at the 18 February, 2004 launch from Baikonur, which was reported to be unsuccessful. A new prototype, the Yu-71 of the Project 4202 program, is thought to have been tested for the first time from Baikonur on 27 December, 2011.[43] Later tests were conducted from the Dombarovskiy missile division site, still using the Kura ICBM test range impact area. Other tests occurred in September 2013, possibly in September 2014, and February 2015.[44] The latest tests occurred on 19 April and 25 October 2016, and 26 December, 2018.

The Yu-70/102E and Yu-71 were launched on top of a repurposed UR-100NUTTH (SS-19) ICBM; the Yu-71 was supposedly launched from the UR-100NUTTH Dombarovskiy basing area (in the Orenburg region) to the target at the Kura Missile Test Range (impact area) on the north-eastern side of the Kamchatka peninsula (about 6,000 kilometers). Russian media sources called the April and October 2016 tests successes.[45] The latest test was also apparently successful. According to

schedule, two UR-100NUTTH missiles armed with the Avangard were reportedly deployed with the Dombarovskiy missile division of its Strategic Nuclear Forces at the end of 2019.[46] Four more systems are planned for that regiment, to make a total of six, while another regiment of six is planned for deployment by 2027.[47] This deployment suggests that, at least for now, Russia plans to deploy nuclear-, rather than conventionally armed, HGVs.

Successful development and deployment of an HGV seems to be the product of what is nominally the second stage of the "target program for the creation of hypersonic weapons," which envisages a global-range system that travels at Mach 10 to 12 and was pitched to the government in 2013 or 2014.[48] Russian officials have generally stressed the increased ability of such systems to evade missile defenses.

In his 1 March, 2018 address to the Federal Assembly, Putin mentioned that the Sarmat (RS-28/SS-29) heavy ICBM could be armed with a "wide spectrum of high-yield nuclear warheads, including hypersonic" ones. It is unclear what type of hypersonic warhead he was referring to, but some believe it could be HGVs. It will likely carry about 10 MIRV warheads, or possibly a smaller number of HGVs, and will replace the Voevoda (SS-18/RS-20V).[49] With three ejection tests completed, the Sarmat is said (at the time of writing) to start flight testing in early 2019.[50] The Sarmat is set to start deployment in 2021 in Uzhur, with at first two missiles, then another four, and eventually having 46 missiles deployed across seven regiments at Dombarovskiy and Uzhur.[51]

Cruise Missiles

Russian officials are relatively transparent with regard to the development and deployment timeline of the 3M-22 Tsirkon missile with anti-ship and land attack variants. This is very likely to be a product of what is described as the type of product of the first stage of the hypersonic missile development program (see below). It might be dual-capable (i.e., capable of carrying either a nuclear warhead or a conventional high-explosive warhead). The missile will reportedly be powered by a solid-propellant boost motor and scramjet engine, have a range of up to 1,000 kilometers, and travel at up to Mach 6 (Putin has stated a range of "over 1,000 kilometers" and a speed of about Mach 9).[52] However, official information about the type of engine the missile will use is not available.

Russia has plans for both basing on submarines and surface vessels.[53] It was reported in IHS Jane's that two Kirov-class cruisers are due to be equipped with this missile. The 3M-22 can apparently be fired from the 3R-14UKSK-Kh Ship General-Purpose Firing System (SGPFS). The system is also capable of launching other sea-based anti-ship, land-attack and torpedo missiles, namely the Kalibr ASCM (3M-14TE) and LACM (3M-54TE and 3M-53TE1) variants, the supersonic BrahMos PJ-10 anti-ship and land-attack variants developed jointly with India, and

the 91RTE2 Kalibr torpedo missile.[54] As for the Russian HGV, NPO Mashinostroyenia, which developed and produced the "Onyx" missile system, leads the experimental design work on the Tsirkon.[55] Ground-based tests, which reportedly started around 2014, continue. Testing from ships and submarines was slated to begin during 2019.[56] A recent test launch conducted from the frigate Admiral Gorshkov in the White Sea was deemed successful.[57] After a failure to resolve Russia's INF Treaty violation and the U.S. suspension of its own treaty obligations, Russian officials announced plans to "launch […] research and development, followed by development and engineering to create land-based launchers for hypersonic intermediate-range and shorter-range missiles."[58]

In 2012 Russia and India agreed to jointly develop the BrahMos II Kalam LACM, also called the BrahMos II K and formerly the BrahMos II. The missile will apparently have a scramjet engine and a kinetic warhead. It is warranted based on a need for increased speed in current conflict situations.[59] Some believe this is the export variant of the developing Tsirkon Russian domestic hypersonic cruise missile.[60] The missile will have a range of over 300 kilometers, is expected to reach initial operational capability (IOC) after 2020, and is slated for air, ground, ship, and submarine deployment.[61] There is some overlap in missile designers and producers reportedly working on this project and other Russian hypersonic projects. NPO Mashinostroyeniya (part of KTRV), TMKB Soyuz, TsIAM, and TsAGI are all apparently working on the BrahMos-II, with NPO Mashinolstroyeniya leading much of the effort to engage Russian enterprises in hypersonic missile technology in 2013.[62]

Russia is also working on hypersonic ALCMs. As an example, work on the Kh-90 apparently continues. Research and development began during the late Soviet period. One product of this work was the GELA (Hypersonic Experimental Aircraft / Giperzvukoviye Experimentalniy Letatelniy Apparat) prototype.[63] Russia has since apparently developed another prototype in this same line, called the GZUR (Hyper-Sonic Guided Missile */Giper-Zvukovaya Upravlaemaya Raketa*) (subject */izdeliye*75). This is likely one of the main products of the hypersonic missile development program's first stage, as envisaged in April 2013. In 2012, a proof-of-concept test with a prototype from earlier work was reportedly conducted at Aktyubinsk in Kazakhstan; the general director of KTRV deemed the test a success.[64] It was also reported that the hypersonic vehicle was being fitted for launch from a Kh-22 (AS-4 "Kitchen") missile, and that in 2012 four Kh-22 missiles were made for testing with the vehicle, with the entire system to be launched from a Tu-22M3.[65] As of early March 2016, the GZUR was in the so-called "technical design stage" at KTRV, meaning that it still needs to undergo testing before deployment.[66] The GZUR is due to receive a ramjet engine (assumed to be a scramjet), and was rumored to enter serial production in 2020.[67]

Also mentioned in Putin's 1 March, 2018 speech is the dual-capable Kinzhal ALCM. It is envisaged to have a range of over 2,000 kilometers, and to be launched from the center pylon of specially modified MiG-31 K interceptors.[68] It has apparently been in "experimental combat duty" since December 2017, suggesting a nearby deployment date.[69] Officials have stressed a capability to overcome anti-air defenses and missile defenses.[70] While it is boasted to travel at Mach 10, this is unlikely given its experimental deployment date. Russia does not seem to have mastered the sustained use of the type of engine needed for a cruise missile to travel at such speeds.[71]

Nuclear-Powered Cruise Missile

Putin announced in his 1 March, 2018 address to Russia's parliament that the country is developing a nuclear-powered, possibly nuclear-armed ALCM. This is the Burevestnik (SSC-X-9 Skyfall).[72] The nuclear-powered engine will fit in the body of a missile like Russia's X-101/X-102 (Kh-101/Kh-102). The X-101/X-102 apparently originally had a range of up to 4,500-5,500 kilometers.[73] Putin noted that the nuclear engine will increase the missile range by a factor of 10.[74] The missile, which could be nuclear armed, was also noted for its envisaged ability to evade missile and air defenses.[75] There is speculation that this missile would actually fly just below hypersonic speed.[76]

Application of Models to Russian Defense Modernization

Military Mission Model

Given the physical capabilities that the hypersonic long-range precision strike weapons grant, the evolution of ideas in Russian military thought from the 20th to the 21st century, and evolution of Russia's foreign policy, it seems that development of these new weapons can be explained, at least partially, by the need to support military missions. The use of new hypersonic weapons fits into the Russian way of war and thinking about strategic stability.

Physical Capabilities

Global development of weapons that travel at hypersonic speeds is the most recent step in the development of long-range "precision-guided" or "high-precision" missile systems. The new types of hypersonic systems or weapons under development today (which generally include terminally guided, conventionally armed ballistic missiles (using a maneuvering reentry vehicle (MaRV) to deliver the warhead), hypersonic glide reentry vehicles (a newer, specific kind of MaRV), and hypersonic cruise missiles with a scramjet engine) are designed to have increased speed, range, maneuverability, accuracy, and precision, and for HGVs, less probability of timely detection.[77] Ballistic missiles with a conventionally armed reentry vehicle that

attacks its target based on kinetics (angle and speed) would need to be much more accurate to ensure that they hit their targets.[78]

Long-Range Precision-Strike Weapons and Modern Conflict

Roots of the significance for military strategy of the intercontinental and long-range hypersonic weapons under development in terms of speed and deepening of the battlefield can be found in Soviet military writings from the 20th century. More recent perceptions of technical necessities for offensive missiles resulted from observing the evolution of the nature of war, especially as waged by countries that Russia considers potential adversaries (especially the U.S.), and which tend to be the world's military leaders in terms of technology, operational art, and theory.[79] For intercontinental missiles and shorter-range cruise missiles, these physical features include higher accuracy, precision, and longer range.[80]

Development of new long-range precision-strike systems, especially conventionally armed cruise missiles, coincides with the expressed need of Russian military leadership to be capable of waging "high technology war." According to Chief of the General Staff and First Deputy Minister of Defense Valeriy Gerasimov in a 2016 article about Russia's experience in Syria, "science and technological developments have changed the character of armed struggle [(war using forceful means)]"; "distanced contactless pressure on the adversary will become the main method of achieving [military] goals with the use of massive employment of high-precision and long-range means of destruction from the air, sea, and space."[81] The 2014 military doctrine similarly notes that "[c]haracteristic features and specifics of current military conflicts" include, among other things, the "massive use of weapons and military equipment systems, high-precision and hypersonic weapons, means of electronic warfare, weapons based on new physical principles that are comparable to nuclear weapons in terms of effectiveness…," "exerting simultaneous pressure on the enemy throughout the enemy's territory on the global information space, airspace and outer space, on land and sea," and other characteristics.[82] The 2010 military doctrine notes similar features but with fewer specifics.[83]

In a 2013 speech on the changing character of war, regarding the "forms and methods" of modern war that the military must prepare and be armed for, Gerasimov noted:

The destruction of [the adversary's] installations is implemented at the entire depth of the territory. The differences between strategic, operational, and tactical levels, offensive and defensive actions are fading. The use of high-precision weapons takes on massive character.[84]

This is an advanced version of the original concept "deep battle." Deep battle was conceptualized in Soviet military thought during the 1920s and 1930s.[85] The

concept of the "deep operation" was developed in Russian military theoretical tradition as the result of the recognition that the industrial revolution (allowing for technological developments in offensive weapons and military transport mechanisms) had made it possible for the front to develop from a single point to an extended line and to have depth in the form of echelons of defense. This line of thought resulted from watching recent wars, including the First World War.[86] Throughout the rest of the 20th century, various technologies transformed the front even further in terms of deepening it physically and expanding its character across different domains of military activity.[87] For example, the vastly increased ranges (i.e. global range) that could theoretically be reached with an HGV embody a prospective historic geographical deepening of the battlefield.

The production rate of currently existing long-range precision-strike weapons—military means of long-range, distanced war in a non-global military theater—and the level of importance placed on their use indicates their perceived power projection value. For example, in terms of sea power, ships with Kalibr cruise missiles, the Bastion shore-based missile system, and the anti-air S-400 system are said to "provide control of the sea and air space," and are being deployed in strategically important regions (i.e. to the Baltic, the Barents, the Black, and Mediterranean seas).[88] In 2018 (at the time of writing), 116 Kalibr missiles are reported to have entered service.[89] A high-ranking Russian military official is noted as saying that the system "'provides…platforms…with significant offensive capability and, with the use of the land attack missile, all platforms have a significant ability to hold distant fixed ground targets at risk using conventional warheads'" and "'is profoundly changing…[the Russian Navy's] ability to deter, threaten, or destroy adversary targets.'"[90] In summary of the important power projection dynamic surrounding Russia's long-range systems, Sokov classified Russian use of its precision-guided, conventional-strike capability as the renewed capability to support the state's foreign policy with military power.[91] In the future, Tsirkon cruise missiles could replace or be used in addition to the Kalibr.

The long-range, precision-strike conventional capability turned out to be not a replacement for nuclear capability in terms of deterrence, but rather an addition to it, evidenced by the dual-capable nature of new weapon delivery systems.[92] The use of hypersonic cruise missiles would heighten the threat of use, and increase the effectiveness of Russian employment of such systems. Development of long-range high-precision systems, including hypersonic ones clearly supports the mission of defending the Russian state, protecting Russian interests past state borders, and projecting power in geographical regions of Russian interest.

Therefore, there is evidence that Russia decided to develop modern hypersonic weapons based on an objective understanding that the character of war has fundamentally changed once again and will continue to change along with

technological developments. Russian military theorists must at least remain on par with the theorists of other states. In logical succession and tasked with helping maintain Russia's great power role on the world stage, the Russian military-industrial complex must technologically supply the necessary means. Thus, there is significant evidence for military missions of strategic and non-strategic hypersonic systems.

Action-Reaction Model

In sync with the action-reaction model, Russian hypersonic weapons are also under development, at least nominally, as a reaction to external stimuli. In this case, the stimuli seem to be certain American offensive and defensive weapons developments. Evidence supporting this can be found mostly in statements by high-ranking state and defense industry officials, writings of former military theoreticians, and the general historical sequence of certain developments. This is stated while keeping in mind the difference between developing a system to keep up-to-date with the changing character of war and new military missions and the observation by Martin van Creveld that "[w]ar…is an imitative activity" on one hand, and responding in a symmetric or asymmetric manner to another country's weapons development based on perceived threats on the other.[93]

The main external military risks that seem most connected to Russia's development of hypersonic long-range high-precision weapons systems include the following, and pointedly relate to the U.S.:

[the] establishment and deployment of strategic missile defense systems undermining global stability and violating the established balance of forces related to nuclear missiles, implementation of the global strike concept, intention to place weapons in outer space, as well as deployment of strategic non-nuclear systems of high-precision weapons.[94]

While Russia's opposition to U.S. missile defenses was not new, this list of threats is part of a policy stance presented in full form for one of the first times in Foreign Minister Sergei Lavrov's January 2011 statement during ratification of New START. They are threats within areas of international security that Russian officials have said affect strategic stability and, therefore, affect Russia's ability to disarm (in the sense of nuclear reductions).[95] The list can be found in a number of other state sources (notably with some subtractions and additions), including in nascent form in the 2010 military doctrine, in the 2015 statement by Russian delegation head Mikhail Uliyanov during the general debate of the Non-Proliferation Treaty Review Conference, and more recently, in a late 2017 presentation by Russian Ambassador to the U.S. Anatoly Antonov.[96] As the Russian position was recently voiced, at least nominally, it may be impossible to have negotiations on further strategic reductions without also discussing such things as the presence of military bases near the

Russian border and the balance of conventional forces.[97]

Prompt Global Strike, Ballistic Missile Defense, and the Asymmetric Approach

As member of the Russian Academy of Sciences and former Secretary of Russia's Security Council Andrei Kokoshin explains, central strategic stability can be thought of as a combination of "vulnerability" and "invulnerability."[98] Put simply, the argument for penetration of missile defenses is largely based on the idea that the combined deployment of U.S. missile defenses and implementation of the prompt global strike concept (PGS) decreases Russia's confidence that the U.S. cannot "deliver a preemptive strike, and that [Russia…is] able to deliver a retaliatory strike under any conditions."[99]

This became official Russian policy in the 2000s, with leaders repeating this perception of the threat over the years.[100] In 2007, then Deputy Minister of Defense Anatoly Antonov noted the "direct link between U.S. plans for global missile defense and the prompt global strike concept which means the ability to strike any point on the globe within an hour of the relevant decision."[101] When the latter is combined with the former, it "becomes a means for world domination, politically and strategically," which "undermines the principles of mutual deterrence and mutual security and erodes the architecture of strategic stability…" In 2013, Gerasimov noted: "The concepts of 'Global strike' and 'Global BMD' are currently being developed. They provide for the infliction of a strike within a few hours on the installations and troops of the adversary located at practically any point on the globe. This is guaranteed to prevent unacceptable damage from the adversary's retaliatory strike."[101] According to the string of logic, this decreases the vulnerability of U.S. strategic assets and population to a second Russian strike, making the U.S. more likely to be able to "win" a nuclear war. The logic follows that confidence in the ability to conduct a strike without the chance of nuclear retaliation would increase the incentive for the U.S. to launch a first disarming strike.[102]

Thus, Russia's leadership seems to have come to a consensus, at least nominally, that the U.S. believes it can attain strategic predominance over Russia. Kokoshin notes an instance of historical precedence. During the 1980s, the Republican Party platform on which Ronald Reagan ran stated that the U.S. should aim to achieve military and technological superiority over the Soviet Union by means of its current (at the time) military build-up. He also recalls that certain Reagan administration officials stated that a nuclear war could be won or lost, (as opposed to it being catastrophic to all involved), and decades of internal U.S. discussion of ways to wage and win nuclear war.[103] Similar to how the Soviet Union viewed the Strategic Defense Initiative (SDI) in the 1980s, and based a plethora of development programs – necessarily or unnecessarily – on the proposed need to counter it, Russia's renewed HGV development and testing, as well as development of other strategic systems, seem to

fit into an asymmetric approach to countering U.S. missile defenses.[104]

The timeline of Russian restarting or starting long-range precision strike weapons programs vis a vis developments on the U.S. side suggests an action-reaction dynamic. Russia apparently resumed testing of its HGV in 2001 – shortly before the George W. Bush administration officialy withdrew the U.S. from the 1972 Anti-Ballistic Missile Treaty.[105] Russian officials viewed the withdrawal as an upset to the basic understandings underlying strategic stability. These include "the premise that nuclear war would have devastating consequences for all mankind," and that missile defense systems are inherently destabilizing.[106] These were established in written form by the 1972 treaty and reaffirmed in the 1990 Soviet-U.S. Joint Statement on Future Negotiations on Nuclear and Space Arms and Further Enhancing Strategic Stability.[107] Indeed, then-Prime Minister Putin wrote in a 2012 election campaign article about asymmetrically, and therefore cost-effectively, preventing an upset to "the global balance of power."[108] This is reminiscent of the cost-effectiveness Premier Mikhail Gorbachev himself apparently discussed during debates about how to respond to SDI.[109]

In terms of military strategy, acting with asymmetry is also characteristic of Russia. The concept of acting with indirectness, "avoiding strengths" and "addressing weaknesses" (both with the use of non-military and military means), have deep roots in the military tradition of Tsarist Russia, the Soviet Union, and modern Russia. Asymmetry and indirectness are ingrained in Russian military tradition, and similar thinking can be seen in other states. It requires ensuring the capability to act indirectly.[110]

Whether the threat posed by missile defenses is as Russian officials categorize it is a matter of debate. Furthermore, the number of deployed U.S. intermediate-range ballistic missile interceptors that Russian officials know could actually present a threat might be significantly fewer than the number that Russian officials have said is acceptable. This weakens the official argument for the need to counter them. In 2011 the Communist Party apparently submitted a proposal for inclusion in the Russian New START ratification resolution indicating that at an upper limit of "200 interceptors capable of intercepting intermediate-range ballistic missiles (effectively, SM-3 Block II interceptors whose deployment is currently scheduled for 2018)" was the point at which the "U.S. development of missile defense capability would be considered dangerous."[111] Sokov has noted that this number is much more lenient than the number over which Russia publicly criticized the U.S. for planning to deploy in Poland during the George W. Bush presidency: 10.[112]

Non-Nuclear "First Disarming Strike" and the Symmetric Approach

Developing conventional high-precision weapons systems, including hypersonic ones, supports the *non-nuclear (conventional) deterrence* strategy. Non-nuclear

deterrence was introduced in the 2014 Military Doctrine as a complex of foreign policy, military and military-technical measures aimed at preventing aggression against the Russian Federation through non-nuclear means.[113]

It is part of the system of *strategic deterrence*, and is said to serve as one means of preventing a first disarming strike with high-precision non-nuclear weapons.[114] The threat has been highlighted by both official and unofficial sources: Putin noted this threat in his 2015 Valdai Forum address, stating that "[a] strategy already exists for a so-called first disarming strike, including with the use of long-range, high-precision non-nuclear weapons, the effect of which may be compared to those of nuclear arms."[115] A Russian expert outlined the counterforce threat more specifically:

…conventional armaments can also present a threat to the survivability of Strategic Nuclear Forces if they possess such characteristics as stealth, high accuracy and destructive capability, as well as comparably short times to reach their target.[116]

Not all in Russia agree that the U.S. and NATO could amass enough conventional forces to launch a disarming strike on Russian strategic installations and their command, control, communication, and information (C3I) assets.[117] Furthermore, not all are convinced that non-nuclear weapons can deter large-scale war, which is what Russia officially suspects from the U.S. and NATO. In the journal *Military Thought*, one former and one serving colonel write, "It is impossible to prevent global (world) war with the threat of retaliatory use of general-purpose force conventional weapons."[118]

Despite internal disagreement, Russia seems prepared to use "strategic non-nuclear forces" in a deterrence, and if necessary, warfighting role to help implement strategic deterrence.[119] Non-nuclear deterrence forces currently include the operational and tactical Russian Iskander-M missile systems in Kaliningrad Region and North Ossetia, submarines and surface ships armed with Kalibr missile systems, and will include long-range aviation airplanes with new X-101 (Kh-101) cruise missiles. Given the Avangard deployment with the Strategic Nuclear Forces, it is likely that only conventionally armed hypersonic cruise missiles would potentially serve as a military means to support this mission.[120]

Possible targets may include U.S. ballistic missile defense installations in Europe (which conventionally or nuclear-armed Iskander missiles based in Kaliningrad are said to be able to reach). The idea of launching non-nuclear de-escalatory strikes corresponds to Kokoshin's writings, wherein he advocates a strategy of "pre-nuclear deterrence."[121] Such a strategy was meant to place more rungs in the ladder of escalation before the "nuclear use" rung, to "enhance…the cogency of deterrence and, consequently, its effectiveness."[122]

Nevertheless, one can characterize Russian development of offensive military and military-technical measures to support non-nuclear deterrence as a form of the symmetric approach, since it involves the development of offensive weapons in response to the development of other threatening offensive weapons.

Nuclear Reductions as External Stimuli

It is also possible that development of long-range high-precision weapons, especially hypersonic ones, might have also made sense given what at the time might have been a realistic possibility of further nuclear reductions. Putin noted the following at the Valdai Forum in 2014:

Today, many types of high-precision weaponry are already close to mass-destruction weapons in terms of their capabilities, and in the event of full renunciation of nuclear weapons or radical reduction of nuclear potential, nations that are leaders in creating and producing high-precision systems will have a clear military advantage.[123]

Gerasimov noted something similar, and more directly related to weapons traveling at hypersonic speeds in a November 2017 speech:

In the future, the pace of development of high-precision weapons and the ongoing development of hypersonic missiles will allow the transfer of a main component of strategic deterrence tasks from the nuclear to the non-nuclear sphere.[124]

Therefore, earlier in the 2000s, before the downturn in arms control, it might have been imaginable that in the future, and especially as nuclear weapons decrease in number, these non-nuclear weapons would be able to take over some roles of nuclear weapons. While numbers of strategic nuclear weapons and delivery vehicles are still controlled, with New START in effect and an existing potential for its extension, some prospects for further strategic nuclear reductions still remain.

Synthesizing the Perceived Threats

Offensive weapons are also developed to evade missile defense systems, forming an asymmetric response. Different kinds of offensive systems are perceived as necessary to deter the use of adversarial offensive systems, constituting a symmetric response. Their development likely also made sense at a time when further nuclear reductions seemed possible.

Therefore, it is possible that the action-reaction model (asymmetric and symmetric responses) partially explains Russia's development of its new strategic offensive hypersonic weapons. However, it cannot be relied upon as a complete explanation for these or for future programs.

Decision-Making Structure and Bureaucratic Interests

After a complete restructuring of the strategic modernization decision-making system in the 1990s, which included the abolition of the original Military-Industrial Commission (MIC), a new MIC was created and assigned many of the same roles as those fulfilled by the Soviet one.[125] Two main responsibilities of the MIC were and still seem to be: conducting the majority of the work in formulating common policy on the development and production of new weapons, as well as playing the role of customer (giving funds to the defense industry for the development and purchases of military equipment).[126] The new MIC is one of 15 Presidential Commissions.[127] Instead of answering to the Politburo, the Commission answers directly to the Russian President. In September 2014, the President was made commission chair, evidently in order to ensure smooth government-wide implementation of the import substitution launched after the West imposed sanctions and Ukraine severed all defense production ties.[128] Through the year 2000, projects for the creation of new strategic weapons systems were mostly continuations of work begun by the Soviet Union.[129] The MIC itself is treated as a continuation of the Soviet body.[130]

In line with the presidential system established by the 1993 Constitution, the President determines the "main tasks of the Russian Federation's military policy in accordance with the federal legislation, the National Security Strategy of the Russian Federation for the Period up to 2020 and the Military Doctrine."[131]

The Collegium of the MIC is the body which ensures that decisions taken by the MIC, as well as state policy on virtually all areas involving the military-industrial complex, including scientific and technological development for domestic defense, and export of military and dual-purpose products, are realized. Importantly, the Collegium also formulates the State Defense Order, and seems to serve as one of two "state customers" for the State Defense Order.[132] Membership of the Commission and of the Collegium overlap. The Collegium is chaired by Yuri Borisov, Russian Vice-Premier and deputy chair of the Commission itself.[133]

Today, as in the past, Ministry of Defense officials sit on the Commission and the Collegium and, thus, have influence over the actual initial decisions made.[134]

Other key MIC members include the minister of finance and the general directors of state corporations that represent a large portion of the Russian defense industry. While KTRV representatives do not sit on the MIC itself, today KTRV's first deputy general director sits on the Collegium "by agreement."[135]KTRV has always been directly connected to the government; the Russian government created it and owns one hundred percent of the corporation's shares.[136]

Defense industry representatives present their projects to the MIC, much like in the Soviet Union. As already noted, KTRV representatives did this with the hypersonic weapons development program during the summer of 2013, and approval was given either during 2013 or in early 2014.

Therefore, this leaves the Ministry of Defense, the Ministry of Finance, and the defense industry as the major bureaucratic players in the decision-making process on development and production of defense equipment. Given the large amount of constitutionally granted power the presidency holds over government processes, it seems to play a role similar to that played by the Politburo, which served as the top layer of the Soviet decision-making bureaucracy. Instead of being answerable to the Politburo, today's MIC is answerable to the President.[137]

There is some evidence of bureaucratic struggle amongst and within all of these groups, which inevitably affects final decisions taken by the MIC on defense production and state armament.[138] This could have affected details of, rather than the very fact of, the hypersonic weapons development program approval. Especially before the Russian President became the chair of the MIC, this final product may have been the result of greater bureaucratic struggles. Even after 2014, some bureaucratic push and pull is present, but this does not appear to change the direction set by earlier decisions.

Actor Interests

Interests of the Russian State (and the executive) in this realm include keeping the Russian military industry flourishing. This allows it to 1) effectively provide the Armed Forces with the means needed to carry out their mission of defending the Russian homeland and national interests, as well as the interests of its allies, 2) help improve the Russian economy (a large portion of its composition is made up of the defense industry) by helping Russia remain one of the largest arms exporters in the world.[139]

The defense industry is most interested in keeping itself afloat and flourishing economically. It does this by developing products relevant to the needs of both Russian and foreign military equipment customers. The Ministry of Defense is interested in maintaining and developing the capability to more effectively defend the Russian homeland, Russian national interests, and the interests of Russia's allies. After the 1990s – years of decline, dilapidation, and desertion largely due to underfunding for the Russian Armed Forces – the Ministry of Defense is also interested in maintaining its own relevance as a great military force to attract Russian citizens to join as a career.

It is in the general interest of the Ministry of Finance to balance the federal budget and ensure that enough funds are allocated to all of the necessary state programs (including healthcare, education, and pensions).

Pushes and Pulls Amongst Defense Industry Enterprises

Today the Russian government does not own all of the defense enterprises, but it

does own a significant amount of them, including those within KTRV. As mentioned, KTRV was created by the government, and, through the Federal Agency for State Property Management (Rosimuchestvo), the Russian government owns all of the company's shares.[140]

Without full transcripts of MIC meetings, it is impossible to know just how democratic the meetings are. Recent transcripts of Putin's opening remarks during meetings show that, as the chair, he brings issues to the table, after which a discussion is supposed to begin.[141] Therefore, at least nominally, there is discussion within the MIC. The voting mechanism of the MIC is unknown. The discussion does not seem to leave the boundaries of the MIC. For example, as far as Parliament members do not sit (or at least currently) on the MIC, the discussion does not officially include the legislative branch of the government.[142]

There could very well be disagreement and competition among defense industry enterprises, which is unimpeded by logic of actual military needs or other bureaucratic mechanisms. During the first meeting in which Putin served as the chair of the MIC, on 10 September, 2014, his opening remarks actually suggested that, like with many group-based processes that have a deadline, the decision-making process can become pretty hectic: "…I hope very much that we can avoid excessive hysteria when the final decisions are made and implementation begins."[143] However, in the case of the hypersonics program, as stated above, it seems that more enterprises were included in the drafting of the program and collaborated on the endeavor than might have been enterprises competing to win contracts for it. As KTRV General Director Obnosov noted, over 60 enterprises worked on the draft.[144] In KTRV alone, there are 36 enterprises, which reportedly comprise over 30% of the Russian defense industry.[145] Using these approximations and assuming percentage can be determined by number of enterprises out of the total, this means that there could be about 120 enterprises in the Russian defense industry. According to this logic, approximately one half of the Russian defense industry could have been involved in the initial collaboration.[146] Cooperation and collaboration on the endeavor also includes portions of the Russian Academy of Sciences and other corporations.[147]

The Ministry of Defense Versus the Defense Industry

Whereas in the late Soviet period the interests of the military and the enterprises that built strategic weapons systems were discordant and production was resultantly supply-driven, the interests of the Russian military and defense industry companies seem to be congruent vis a vis type of new hypersonic weapons development.[148] What the Ministry of Defense needs gives many defense industry actors something to do. As evidenced by the military mission section, the output of new high-precision weapons and the new hypersonic weapons that are under development seem to be in

line with military doctrine, as well as the writings and speeches of military leadership discussing the means viewed as necessary to conduct "high technology war" (see below) and effectively carry out Russia's strategic deterrence strategy.

The Russian President's oversight of the MIC, which increased after he became the chair of the body in 2014, has likely helped ensure this smoothness. One should note that, within this top-down dynamic, Putin favors rebuilding the Russian military. This is evidenced by past policies he approved, and his 2012 campaign article arguing for a strong Russian military.[149]

Among Ministry of Defense Personnel

While evidence of disagreement among Ministry of Defense personnel is scarce, there are signs that not all agree on the viability of a "first disarming strike" on Russian Strategic Nuclear Forces with the use of non-nuclear high-precision systems. Those who believe this to be viable likely base it on the idea that the U.S. would assume that in such a scenario Russia would not choose to respond with nuclear weapons after absorbing such a strike, since that would necessarily warrant U.S. nuclear retaliation.[150]

An officially adopted non-nuclear deterrence strategy seems to be the means by which Russia plans to deter such a strike. Despite official agreement on this, Ministry of Defense think tank officials have noted that "[s]ubstantive counterarguments of domestic specialists are ignored and silenced by those who side with such disarming, as if they do not exist."[151] These substantive counterarguments provide logic behind why such an attack is not only highly unlikely, but physically impossible in the foreseeable future.[152] Thus, it seems that arguments which rely on alternate calculations, an historic mistrust of the U.S., a necessity for all militaries to prepare for the worst case scenario, a desire to help feed long-term prosperity of portions of the defense industry and help ensure another mission for the Russian military, or other reasoning have won out.

The Defense Industry and the Ministry of Defense Versus the Ministry of Finance

Tensions between the Ministry of Defense and defense industry on the one hand and the Ministry of Finance on the other have drastically decreased since defense funding reached an historically low point in the 1990s. Nevertheless, some do still exist.[153] As Mathieu Boulègue explains, Putin himself noted this during a visit to the Kalashnikov factory in Izhevsk: "Of course questions of state capabilities, budget possibilities and demands of the Armed Forces always exist. Here we need to find the golden medium at which our expenses in the defense sphere will not suppress all of our other demands related to social issues, social security, pensions, healthcare, education…"[154] Underfunding of the Ministry of Defense helped fuel anti-presidency sentiments during the 1990s. Given historical memory, it is in the

interest of the political party in power to ensure that the needs of both the defense industry and, especially, the Ministry of Defense are satisfied.[155]

Summing Up the Bureaucratic Dynamics

There is evidence of bureaucratic struggle among all of these groups, and within some of these groups, which inevitably has and does affect final decisions taken by the MIC on defense production and state armament. But it seems this is not the main driver behind picking up where the Soviet Union left off with hypersonics. The major bureaucratic actors include the Ministry of Defense and the defense industry on one side representing the need for defense spending, and the Ministry of Finance on the other representing the voice of state budget concerns. Disagreements among defense industry enterprises are not so visible publicly, and it seems that, the largesse of the hypersonic weapons development program is in the interest of as many enterprises as can get contracts. The interests of the Ministry of Defense and the defense industry as a whole seem to align. Evidence suggests that within the Ministry of Defense, opinions favoring decreased or alternate threat perceptions did not move far in the decision-making process for historical, monetary, and political reasons. Thus, it seems that, rather than working-level disagreements and bureaucratic inertia overriding military interests, as characteristic during the 1970s, a more organized, top-down management style has allowed for a demand-driven process.

Implications

Of the three models applied above, Russia's decision to acquire intercontinental- and shorter-range hypersonic weapons is best explained by a mixture of the military mission model and the action-reaction model. Bureaucratic pushes and pulls among the various actors, while present, do not seem to have been a significant factor that led to the adoption of the hypersonic weapons development program. To use a physics analogy, the military missions that reflect the latest wave of military technical revolution in favor of (at least nominally) faster, high-precision weapons as means of deterrence and of deepening the battlefield, the threats from abroad that were perceived and determined to warrant symmetric and asymmetric responses, can be seen as coalescing into the "mass" variable of the "hypersonic weapons development program" momentum. While this piece does not measure the magnitude of the weapons development "velocity," the direction is surely forward.

There are a number of implications of this. One main and rather obvious one is that the weapons Russia develops and tests in this realm have a definite envisioned utility that precedes their deployment. Their production is driven by demand rather than supply. It is unlikely to lead to any "unintended posture," the type of which confused U.S. analysts who watched the Soviets fail to mitigate the potentially destabilizing consequences of having a strategic force composed largely of heavily

MIRVed silo-based ICBMs in the 1970s.[156] Unlike deciphering reasoning behind late Soviet strategic nuclear force posturing, pairing these new strategic and non-strategic means with their missions is more straightforward. When Russian leaders talk about developing and deploying similar systems, they should be taken seriously.

This leads to a second implication: Russia either is or is becoming an arms control negotiating partner with qualitatively-equivalent capabilities in the realm of precision-strike weapons. The issue of definition and whether or not to include conventionally armed boost-glide systems arose during New START negotiations. At this time, the U.S. was ahead of Russia in the development of hypersonics. The U.S. held to the position that "'future non-nuclear systems of strategic range that do not otherwise meet the definitions of the treaty should not be considered new kinds of strategic offensive arms for the purposes of this treaty.'"[157] Russia was of the position that conventionally armed boost-glide systems might serve as "'a new kind of strategic offensive arm.'"[158] According to New START Article 5(2), anything given that definition may trigger discussions in the Bilateral Consultative Commission (BCC) regarding whether and by what means to regulate the systems.[159] With Russia's HGVs deployed and more on the way, and U.S. HGVs under development, this discussion could arise in the near future.

In 2018 when presenting Russia's Avangard, Putin noted: "Why did we do all this? Why did we talk about it? […] we made no secret of our plans and spoke openly about them, primarily to encourage our partners to hold talks. […] nobody really wanted to talk to us about the core of the problem, and nobody wanted to listen to us. So listen now."[160] While other evidence suggests this was not the sole purpose, actually deploying an HGV gives Russia a stronger negotiating position from which to discuss boost glide systems (nuclear- or conventionally armed, at this point). More research on developing weapons in connection to desired negotiating position is warranted.

Shorter-range precision-strike systems, including those that fly at hypersonic speeds, have also shown their power projection and coercive utility in regional settings for Russia. Their use during the Syrian conflict proved this for Russian military leadership.[161] With the INF Treaty out of effect, there is even less of a starting place from which to begin discussing limits on such systems. Nevertheless, if the U.S. and Russia do come to the negotiating table on longer- or short-range precision-strike systems, including ones that fly at hypersonic speeds, the U.S. will find it must work with a partner that sees just as strong a utility for these weapons systems in its military and national security strategy as the U.S. does.

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Notes

1. As of publication date, New START has been extended to 2026.

2. The White House, *Statement from the President Regarding the Intermediate-Range Nuclear Forces* (INF) Treaty, Washington, DC February 1, 2019, https://www.whitehouse.gov/briefings-statements/statement-president-regarding-intermediate-range-nuclear-forces-inf-treaty/?utm_source=twitter&utm_medium=social&utm_campaign=wh as referenced in Amy F. Woolf, "Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress," Congressional Research Service, August 2, 2019, 1, https://crsreports.congress.gov/product/pdf/R/R43832/38; President of Russia, "Meeting with Sergei Lavrov and Sergei Shoigu," February 2, 2019, Moscow, http://en.kremlin.ru/events/president/news/59763.

3. Alexey Arbatov, "An Unnoticed Crisis: the End of History for Nuclear Arms Control?" Carnegie Moscow Center, March 16, 2015, http://carnegie.ru/2015/03/16/unnoticed-crisis-end-of-history-for-nuclear-arms-control-pub-59378.

4. This could fall into the New START Article 5(2) category of "a new kind of strategic offensive arm."

5. "Meeting with Sergei Lavrov and Sergei Shoigu."

6. Stephen Meyer, "Soviet National Security Decisionmaking: What Do We Know and What Do We Understand?" in ed. Jiri Valenta and William Potter, Soviet *Decisionmaking for National Security* (London: George Allen & Unwin, 1984), 256-279.

7. Ibid.

8. Nikolai Sokov, *Russian Strategic Modernization: Past and Future*, (Lanham: Rowman & Littlefield, 2000).

9. Ibid, 257-268, 275.

10. Meyer, "Soviet National Security Decisionmaking," 257.

11. See Alexander Dallin, "The Domestic Sources of Soviet Foreign Policy" in Seweryn Bialer ed.,*The Domestic Context of Soviet Foreign Policy* (Boulder: Westview Press, 1981), 346-347, and 364 note 78, and Celeste Wallander, "The Sources of Russian Conduct: Theories, Frameworks, and Approaches," in *The Sources of Russian Conduct After the Cold War*, ed. Celeste Wallander (Boulder: Westview Press, 1996) as referenced in Sokov, *Russian Strategic Modernization*, 261-265.

12. Pavel Podvig, "Russian Nuclear Strategy," Center for Strategic and International Studies, June 27, 2016, 9:55-13:00, https://www.csis.org/events/russian-nuclear-strategy.

13. Pavel Podvig and Alexander Stukalin, "Russia Tests Hypersonic Glide Vehicle,"*IHS Jane's*, June 4, 2015;Pavel Podvig, "Document Details Soviet Response to the Star Wars Missile Defense Program,"*Russian Strategic Nuclear Forces*(blog), March 21, 2018, http://russianforces.org/blog/2018/03/document_details_soviet_respon.shtml.

14. Meeting of the Valdai International Discussion Club, President of Russia, October 24, 2014, http://en.kremlin.ru/events/president/news/46860, as referenced in Arbatov, "An Unnoticed Crisis."

15. "Boris Satovsky: Hypersonic Aircraft Will Break Through Missile Defenses," (*Boris Satovsky: Gipersvukovie Letatelnie Apparati Prorvut PRO*), *Ria Novosti*, December 16, 2016, https://ria.ru/20161216/1483773921.html.

16. William Wolforth, *The Elusive Balance: Power and Perceptions During the Cold War* (Ithaca: Cornell University Press, 1993), 189 as referenced in Sokov,*Russian Strategic Modernization*, 4.

17. Meyer, "Soviet National Security Decisionmaking," 257.

18. Ibid, 257.

19. Ibid, 259-260

20. Jiri Valenta, "Soviet Decisionmaking in Czechoslovakia, 1968," in Jiri Valenta and William Potter ed., *Soviet Decisionmaking for National Security,*166.

21. Ibid, 166.

22. Nikolai Sokov, "Bureaucratic and Interest Group Explanation for Soviet Policy," (doctoral dissertation, The University of Michigan, 1996), 1-2.

23. Dallin, "The Domestic Sources of Soviet Foreign Policy," 346-347, and 364 note 78.

24. Meyer, "Soviet National Security Decisionmaking," 261.

25. See Dallin, "The Domestic Sources of Soviet Foreign Policy" 346-347, and 364 note 78, and Celeste Wallander, "The Sources of Russian Conduct" as referenced in Sokov, *Russian Strategic Modernization*, 5. See also Meyer, "Soviet National Security Decisionmaking," 261-265.

26. See discussions on government and defense decision-making structure in Sokov, "Bureaucratic and Interest Group Explanation for Soviet Policy," 6 and Elizabeth Teague, "Pluralism Versus Corporatism: Government, Labor, and Business in the Russian Federation," in Anthony Jones and Carol R. Saivetz ed.,*In Search of Pluralism: Soviet and Post-Soviet Politics*, (Boulder: Westview Press, 1994) 110.

27. Meyer, "Soviet National Security Decisionmaking," 266.

28. Ibid.

29. Ibid, 267.

30. Sokov, *Russian Strategic*Modernization, 2, 5.

31. Amy Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues," Congressional Research Service, February 3, 2017, 8, https://fas.org/sgp/crs/nuke/R41464.pdf; James Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*, Carnegie Endowment for International Peace, 5-6, http://carnegieendowment.org/2013/09/03/silver-bullet-asking-right-questions-about-conventional-prompt-global-strike- pub-52778.

32. Acton, *Silver Bullet?* 5-6.

33. Protocol to the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, paragraphs 6 and 10, https://www.state.gov/documents/organization/140047.pdf; Treaty Between the United States Of America And The Union Of Soviet Socialist Republics On The Elimination Of Their Intermediate-Range And Shorter-Range Missiles (INF Treaty), Article II (1, 2), https://www.state.gov/t/avc/trty/102360.htm#text.

34. This high speed forces air from the atmosphere through the ramjet engine at maintained supersonic speeds, allowing the vehicle to continue traveling forward at hypersonic speed. Vehicles without any initial booster engine that travel at supersonic speeds (below approximately Mach 4) use ramjet engines. These do not have the compressors (fans) used in jet engines; the supersonic speed forces oxygen through the engine at subsonic speeds.Acton,*Silver Bullet?*, 54.

36. The issue of using such conventional weapons systems in deterrence roles previously reserved for nuclear weapons became part of U.S. debate about arming its own systems in the early 2000s. See Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles," 7.

37. Action, *Silver Bullet?*, 65-78.

38. "KTRV General Director Boris Obnosov: 'the First Hypersonic Aircraft Will Come Out at the Beginning of the Next Decade," (*Gendirektor KTRV Boris Obnosov: 'Pervie GiperzvukovieLetatelnie Apparati Poyavyatsa v Nachale Sleduyushevo Desyatiletiya'*),*Interfax-AVN*, http://militarynews.ru/story.asp?rid=2&nid=439291;

39. "About the Corporation," (*O korporatsii*), JSC Tactical Missile Corporation, http://www.ktrv.ru/about/?PHPSESSID=8ba7b8635d1db0af43b49d95b25dfd69.

40. Lecture by Commander-in-chief of the Russian Air Force Alexander Zelin at an April 2013 aviation manufacturer convention in Moscow as referenced in Piotr Butowski, Rajendrakumar Doraisamy and Marina Malenic, "Hypersonic Hustle: Global Efforts Stepped-Up to Satisfy Military Need for Speed,"*Jane's International Defence Review*, March 9, 2016.

41. "Address of the President to the Federal Assembly," (*Poslanie Presidenta Federalnovu Sobraniu*), President of Russia, March 1, 2018, http://kremlin.ru/events/president/news/56957.

42. "Programs for Countering BMD," Archive of V. L. Kataev, http://russianforces.org/Katayev_Anti-SDI_Programs_Web.pdf, as referenced in Podvig, "Document Details Soviet Response to the Star Wars Missile Defense Program"; Vladimir Dvorkin, "Hypersonic Threats: The Need for a Realistic Assessment," Carnegie Moscow Center, August 9, 2016, http://carnegie.ru/2016/08/09/hypersonic-threats-need-for-realistic-assessment-pub-64281.

43. Pavel Podvig, "Summary of the Project 4202 Developments,"*Russian Strategic Nuclear Forces*(blog), June 16, 2015, http://russianforces.org/blog/2015/06/summary_of_the_project_4202_de.shtml.

44. Pavel Podvig, "Avangard System is Tested, Said to be Fully Ready for Deployment,"*Russian Strategic Nuclear Forces*(blog), December 26, 2018, http://russianforces.org/blog/2018/12/avangard_system_is_tested_said.shtml.

45. "SRF Launched UR-100NUTTKh from Orenburg Region to Kamchatka," (*RVSN Zapustili UR-100NUTTKh iz Orenburgskoy Oblasti na Kamchatku)*, *Lenta.ru*,October 25, 2016, https://lenta.ru/news/2016/10/25/ur100/; "In Russia Tests of the RS-18 Ballistic Missile with a Hypersonic Warhead Were Conducted," (*V Rossii Proshli Ispitania Ballisticheskoy Raketi RS-18 s Giperzvukovim Boevim Blokom*), *Interfax*, April 21, 2016, http://www.interfax.ru/russia/504894; "RVSN Successfully Launched RS-18 Ballistic Missile Development by 'JSC 'NPO Mashinostroyenia" to the Test Site on the Kamchatka Peninsula,"(*RVSN Uspeshno Zapustili Balilsticheskuyu Raketu RS-18 Razrabotki AO "VPK "NPO Mashinostroyenia" po Poligonu na Kamchatke*), NPO Mashinostroyenia, 25 October, 2016, http://www.npomash.ru/press/ru/podrobnee251016.htm?l=0; Podvig and Stukalin, "Russia Tests Hypersonic Glide Vehicle."

46. Pavel Podvig, "Avangard Begins Combat Duty,"*Russian Strategic Nuclear Forces* (blog), December 27, 2019, http://russianforces.org/blog/2019/12/avangard_begins_combat_duty.shtml.

47. Podvig, "Avangard System is Tested, Said to be Fully Ready for Deployment"; "Source: the First 'Avangard' Systems Will Enter Combat Duty," (*Istochnik: pervie kompleksi 'Avangard' vstanut na boevoe dezhurstvo v 2019 godu*), *TASS*, October 29, 2018, https://tass.ru/armiya-i-opk/5731436, as referenced in Pavel Podvig, "Avangard Hypersonic Boost-Glide System Deployment Plans,"*Russian Strategic Nuclear Forces* (blog), October 29, 2018, http://russianforces.org/blog/2018/10/avangard_hypersonic_boost-glid.shtml.

48. The former commander-in-chief of the Russian Air Force apparently noted this at a convention of aviation manufacturers in Moscow. See Butowski, Doraisamy and Malenic, "Hypersonic Hustle." Something similar was reportedly said by the General Director of KTRV, Boris Obnosov at the 2013 Moscow Air Show.See "*Russian Scientists Were Told to Creat a Hypersonic Aircraft*,"*(Rossiskim Uchyonim Poruchili Sozdat Giperzvukovoy*

Letatelniy Apparat),*Interfax*, May 3, 2017, http://www.interfax.ru/russia/560994.

49. Hans M. Kristensen and Matt Korda, "Russian Nuclear Forces, 2019,*Bulletin of the Atomic Scientists*, Vol. 75, No. 2, March 4, 2019, https://www.tandfonline.com/doi/full/10.1080/00963402.2019.1580891; "Address of the President to the Federal Assembly," March 1, 2018.

50. "Source: the First Tests of the 'Sarmat' Missile Are Scheduled for Early 2019," (Istochnik: pervie letnie ispitania raketi 'Sarmat' planiruetsa provesti v nachale 2019 goda,)*TASS*, October 1, 2018, https://tass.ru/armiya-i-opk/5625163 as referenced in Pavel Podvig, "Sarmat to Begin Flight Tests in 2019,"*Russian Strategic Nuclear Forces*(blog), October 3, 2018, http://russianforces.org/blog/2018/10/sarmat_to_begin_flight_tests_i.shtml; Pavel Podvig, "Sarmat Deployment is Said to Begin in 2021,"*Russian Strategic Nuclear Forces*(blog), October 31, 2018, http://russianforces.org/blog/2018/10/sarmat_deployment_is_said_to_b.shtml.

51. "Source: Serial Production of the New 'Sarmat' Missile Will Begin in 2021," (*Istochnik: seriinoe proizvodstvo noveyshikh raket 'Sarmat' nachnyotsa v 2021 godu*),*TASS*, Octover 31, 2018, https://tass.ru/armiya-i-opk/5740651, as referenced in Pavel Podvig, "Sarmat Deployment is Said to Begin in 2021,"*Russian Strategic Nuclear Forces* (blog), October 31, 2018, http://russianforces.org/blog/2018/10/sarmat_deployment_is_said_to_b.shtml;

52. Dr. Lee Willet, "Game Changer: Russian Sub-Launched Cruise Missiles Bring Strategic Effect,"*Jane's International Defense Review*, April 27, 2017; Article by NPO Mashinostroyenia Deputy General Director Alexander Dergachev and two other colleagues as referenced in "The Russian Navy Will Receive a Hypersonic Missile After 2020," (*VMF Rossii Poluchit Giperzvukovuyu Raketu Posle 2020 Goda*),*Interfax*, April 13, 2016, http://www.interfax.ru/russia/503530; "During the Spring Russia Will Test the "Tsirkon" Hypersonic Missile from a Sea Launcher," *(Vesnoi Rossia Vpervie Ispitaet Giperzvukovovo Raketu 'Tsirkon' s Morskovo Nositelya*), *Interfax*, February 8, 2017, http://www.interfax.ru/russia/549055; "Address of the President to the Federal Assembly," (*Poslanie Presidenta Federalnomu Sobraniu*), President of Russia, February 20, 2019, http://kremlin.ru/events/president/news/59863.

53. This was according to a "source close to the Military-Industrial Commission, as referenced in "The Russian Navy Will Receive a Hypersonic Missile After 2020," (*VMF Rossii Poluchit Giperzvukovuyu Raketu Posle 2020 Goda*),*Interfax*, April 13, 2016, http://www.interfax.ru/russia/503530; "Missile Complexes for Armament of the Russian Navy,"(*Raketniye Kompleksi na Vooruzhenii VMF*), Joint Stock Company Military-Industrial Corporation NPO Mashinosroyenia, http://www.npomash.ru/activities/ru/rocketvmf.htm.

54. "Source: Russian "Tsirkon" Missile Reached Mach 8 in Testing," (*Istochnik: Rossiyskaya Raketa "Tsirkon" Dostigla na Ispitaniyakh vosmi Skorosti Zvuka), TASS*, April 15 2017. The full range of missiles able to be launched by this system include the "3M-54TE, 3M-54TE1, BrahMos PJ-10 antiship missiles; 3M-14TE, BrahMos PJ-10 land-attack missiles; and 91RTE2 torpedo missiles for underwater target engagement."See JSC Concern Morinformsystm-Agat, 3R-14UKSK-Kh Ship General-Purpose Firing System, https://concern-agat.ru/en/production/missile-systems-land-and-sea-based-missile-systems/3r-14uksk-kh-ship-general- purpose-firing-system.html; Jane's Weapons: Naval,"3M-22 Tsirkon," April 3, 2017.

55. "Russia Will Receive Hypersonic Weapons at the Beginning of the Next Decade," (*Rossiya Poluchit Giperzvukovoe Oruzhie v Nachale Sleduyushevo Desyatiletia*), *Interfax*, September 26, 2016, http://www.interfax.ru/russia/529899; "VMF Rossii Poluchit Giperzvukovuyu Raketu Posle 2020 Goda, (The Russian Navy Will Receive a Hypersonic Missile After 2020)," *Interfax*, April 13, 2016, http://www.interfax.ru/russia/503530.

56. "Source: over 10 launches of the "Tsirkon" at naval targets have been conducted since it entered testing," (*Istochnik: bolee 10 puskov 'Tsirkona' po morskim tselyam provedeno s nachala evo ispitanii*), *TASS*, December 21, 2018, https://tass.ru/armiya-i-opk/5942271.

57. "Frigate "Admiral Gorshkov" Performed a Missile Test in the White Sea," (*Fregat "Admiral Gorshkov" viypolnil ispiytatelnuyu raketnuyu strelbu v Belom morye*), Russian Ministry of Defense, November 26, 2020, https://function.mil.ru/news_page/country/more.htm?id=12326790@egNews.

58. "Meeting with Sergei Lavrov and Sergei Shoigu."

59. "BRAHMOS Hypersonic Cruise Missile," BrahMos Aerospace, accessed May 15, 2018, http://www.brahmos.com/content.php?id=27.

60. "3M-22 Tsirkon,"*Jane's Weapons: Naval*, April 3, 2017; Rahul Singh, "India's Tribute to Missile Man: New BrahMos Gets Kalam Name,"*The Hindustan Times,*August 8, 2015, http://www.hindustantimes.com/india/india-s-tribute-to-missile-man-new-brahmos-gets-kalam-name/story-mWxzOK5B XMJGmpg8o7LU2N.html.

61. See Acton, *Silver Bullet?* 105; BrahMos Aerospace, "India, Russia to Develop New Hypersonic Cruise Missile," 9 October 2009; U.S. Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic Missile and Cruise Missile Threat*, July 21, 2017, 37, https://www.nasic.af.mil/Portals/19/images/Fact%20Sheet%20Images/2017%20Ballistic%20and%20Cruise%20Missile %20Threat_Final_small.pdf?ver=2017-07-21-083234-343.

62. *Interfax*, April 23, 2013 as referenced in Alexander Zudin, "Russia to Draft Hypersonic Missile Programme in Mid-2013,"*Jane's Defence Weekly*, April 25, 2013.

63. GELA (KH-90),"*Jane's Air-Launched Weapons*, October 23, 2012 as referenced in Acton, *Silver Bullet?* 106.

64. Zudin, "Russia to Draft Hypersonic Missile Programme in Mid-2013." KTRV was formed via the combination of design and production enterprises, also including NPO "Vympel" and "Zvezda-Strela."*Izvestiya*report as referenced in David C. Isby, "Russia Plans Hypersonic Test Flights,"*Jane's Missiles & Rockets*, February 1, 2013; "Russia Will Receive Hypersonic Weapons at the Beginning of the Next Decade," (*Rossiya Poluchit Giperzvukovoe Oruzhie v Nachale Sleduyushevo Decitiletiya*). The 2012 test may have been a 2012 "captive carry flight" test, in which a prototype was carried by a Tupolev Tu-22M3 (NATO designation 'Backfire') long-range bomber. See Butowski, Doraisamy and Malenic, "Hypersonic Hustle"; Dr. Carlo Kopp, "Tupolev Tu-22M3 Backfire C Bomber – Missile Carrier; Туполев Ту-22М3 Бомбардировщик-ракетоносец," Air Power Australia, last updated January 27, 2014.

65. Butowski, Doraisamy and Malenic, "Hypersonic Hustle".

66. Ibid.

67. Leonid Nersisyan, "What Will Future Plane Engines Be Able to Do?" (*Shto Smogut Aviatsionnie Dvigateli Budushevo?*),*New Defense Order Strategy*, No. 6 (53), 2018, 44, http://dfnc.ru/wp-content/uploads/2018/11/NOZ_0653_2018_END_coverblock.pdf.

68. "Address of the President to the Federal Assembly"; Yuri Podkopaev, "The Fate of the 'Terminator,' Premier of the "Buk-3," New Pilotless Aparatus: Interview with Deputy Defense Minister Borisov," (*Sudba "Terminatora," Premyera "Buk-3," Novie Bespilotniki: Intervyu s Zamministra Oboroni Borisovim*), May 5, 2018, https://tvzvezda.ru/news/forces/content/201805051128-ifip.htm.

69. Russian Ministry of Defense, "In Moscow Under the Leadership of the Supreme Commander of the Russian Armed Forces Vladimir Putin, an Extended Meeting of the Board of the Ministry of Defense was Conducted," (*V Moskve pod Rukovodstvom Verkhovnovo Glavnokomanduyushevo Vooruzhennimi Silami Rossii Vladimira Putina Proshlo Rasshirennoe Zacedanie Kollegii Minoboroni*), December 18, 2018, https://function.mil.ru/news_page/country/more.htm?id=12208613@egNews.

70. Podkopaev, "The Fate of the 'Terminator.'"

71. "Address of the President to the Federal Assembly," March 1, 2018; https://iz.ru/695749/sergei-valchenko/massovogo-giperzvukovogo-oruzhiia-ne-stoit-ozhidat; Sergey Valchenko, " 'It Is Not Worth Waiting for Massive Hypersonic Weapons,'" (*Massovovo Giperzvukovovo Oruzhia ne Stoit Ozhidat*), *Izvestia*, January 18, 2018, https://iz.ru/695749/sergei-valchenko/massovogo-giperzvukovogo-oruzhiia-ne-stoit-ozhidat; "What Will Future Plane Engines Be Able to Do?" 44.

72. Amy F. Woolf, "Russia's Nuclear Weapons: Doctrine, Forces, and Modernization," Congressional Research Service, July 20, 2020, 25, https://crsreports.congress.gov/product/pdf/R/R45861/6; "Cruise Missile With a Nuclear Engine 'Burevestnik,'" (*Krilataya raketa s yadernoi energeticheskoi ustanovkoi*), Russian Ministry of Defense, accessed February 27, 2019, https://vote.mil.ru/vote/krnd.htm.

73. "The Unsurpassed Kh-101: All About Russia's Latest Cruise Missile," (*Neprevzoidennaya X-101: vsyo o noveyshey krilatoy rakete Rossii*),*Telekanal Zvezda*, October 6, 2018, https://tvzvezda.ru/news/opk/content/201610061845-4uh6.htm.

74. "Address of the President to the Federal Assembly," March 1, 2018.

75. Ibid.

76. Leah Walker, "Nuclear-Powered Cruise Missiles: Burevestnik and its Implications,"*Journal of Science Policy & Governance*, Vol. 16, No. 1, April 2020, https://www.sciencepolicyjournal.org/uploads/5/4/3/4/5434385/walker_jspg_v16.pdf.

77. "Address of the President to the Federal Assembly," March 1, 2018.

78. Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles," 8-9.

79. James J. Tritten,*Military Doctrine and Strategy in the Former Soviet Union: Implications for the Navy*, Naval Post Graduate School, August 1993, https://apps.dtic.mil/dtic/tr/fulltext/u2/a275846.pdf.

80. "The Russian Navy – A Historic Transition," Office of Naval Intelligence, December 2015, https://www.documentcloud.org/documents/3549407-The-Russian-Navy-A-Historic-Transition-2015.html #document/p2, 36.

81. Valery Gerasimov, "According to the Syrian Experience," (*Po Opitu Sirii*) *Military-Industrial Courier*, March 9, 2016, https://vpk-news.ru/articles/29579.

82. The Embassy of the Russian Federation to the United Kingdom of Great Britain and Northern Ireland, "The Military Doctrine of the Russian Federation," press release, June 29, 2015, paragraph 15 (b, c, d, and f), https://rusemb.org.uk/press/2029.

83. See The Military Doctrine of the Russian Federation, (*Voennaya doktrina Rossiyskoi Federatsii*), President of Russia, February 5, 2010, paragraph 12, http://kremlin.ru/supplement/461.

84. Valeriy Gerasimov, "The Value of Science in Prediction: New Challenges Require the Rethinking of Forms and Methods of Combat Operations," (*Tsennost nauki v predvidenii: noviye vizovi trebuyut pereosmislit formi Isposobi vedeniya boevikh deystvii*),*Military-Industrial Courier*, no. 8 (476), February 27, 2013, http://www.vpk-news.ru/articles/14632.

85. See *Brigade Commander Georgii Samoilovich Isserson: The Evolution of Operational Art*, (For Leavenworth: Combat Studies Institute Press, July 2013), http://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/OperationalArt.pdf.

86. Richard Holmes, "Battle: The Experience of Modern Combat,"in Charles Townshend ed., *The Oxford History of Modern War*, (Oxford: Oxford University Press, 2005), 221-222, 230.

87. Gerasimov, "The Value of Science in Prediction."

88. Speech of the Chief of the Russian Federation Armed Forces General Staff—First Russian Federation Deputy Defense Minister, Army General Valeriy Gerasimov at the Public Meeting of the Defense Ministry Collegium, November 7, 2017, https://function.mil.ru/news_page/country/more.htm?id=12149743@egNews.

89. "The Russian Minister of Defense Conducted the Day of Acceptance of Military Products," (*Ministr oboroni Rossii provyol Ediniy den priemki voennoy produktsii*), *TVZvezda*, December 1, 2018,

https://tvzvezda.ru/news/forces/content/c95baa0d6200be34d6b9f16e34ea3f28ce7eb3cb523b2ea9b5b4bf44c05ac605.

90. High ranking Russian defense industry official, 12 December 2011, as referenced in "The Russian Navy – A Historic Transition," 34.

91. Nikolai Sokov, "Russia's New Conventional Capability: Implications for Eurasia and Beyond," PONARS Eurasia, May 2017, http://www.ponarseurasia.org/memo/russias-new-conventional-capability-implications-eurasia-and-beyond.

92. Sokov, "Russia's New Conventional Capability: Implications for Eurasia and Beyond"; V.I. Levshin, A.V. Nedelin, and M.E. Sosnovskiy, "On the Use of Nuclear Weapons for De-Escalation of Military Activities," (*O primenenii yadernovo oruzhia dlya deeskalatsii voennikh deystviy*), *Military Thought*, 1999; Olga Oliker, "Moscow's Nuclear Enigma,"*Foreign Affairs*, November/December 2018, https://www.foreignaffairs.com/articles/russian-federation/2018-10-15/moscows-nuclear-enigma.

93. Martin van Creveld, "Technology and War I: To 1945," in Charles Townshend ed.,*The Oxford History of Modern War*, (Oxford: Oxford University Press, 2005), 221.

94. "The Military Doctrine of the Russian Federation," June 29, 2015, paragraph 12(d).

95. "Transcript of a Statement by Foreign Minister of the Russian Federation Sergey Lavrov at a Plenary Meeting of the State Duma of the Federal Assembly of the Russian Federation on the New START Treaty," (*Stenogramma Vystupleniya Ministra Inostrannykh Del Rossii S.V. Lavrova na Plenarnom Zasedanii Gosudarstvennoi Dumy Federalnogo Sobraniya Rossiiskoi Federatsii npo Novomy Dogovoru o SNV*), January 14, 2011), Russian Ministry of Foreign Affairs, January 14, 2011, document 20-14-01-2011, http://www.mid.ru/ru/press_service/minister_speeches/-/asset_publisher/7OvQR5KJWVmR/content/ id/222382.

96. President of the Russian Federation, The Military Doctrine of the Russian Federation, February 5, 2010, paragraph 8(г). As noted above, in 2015 the head of Russia's NPT Review Conference delegation listed the deployment of missile defenses, implementation of prompt global strike, attempts to halt negotiations on a treaty to prevent the placement of weapons in outer space and a lack of movement towards ratifying the CTBT as lying within the category of hindrances to future nuclear reductions. Mikhail Uliyanov, "Statement Submitted at the 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons," (statement, New York, April 27, 2015,) http://reachingcriticalwill.org/images/documents/Disarmament-fora/npt/revcon2015/statements/27April_Russia.pdf; Anatoly Antonov, "New Russian Ambassador to U.S. Meets with Middlebury Institute Students," (presentation, Middlebury Institute of International Studies at Monterey, Monterey, CA, November 30, 2017), 6:22-7:51, https://www.nonproliferation.org/new-russian-ambassador-to-us-meets-with-middlebury-institute-students/.

97. Ambassador Anatoly Antonov, Monterey, November 30, 2017.

98. Andrei Kokoshin, "Ensuring Strategic Stability in the Past and Present: Theoretical and Applied Questions," Belfer Center for Science and International Affairs, 35, https://www.belfercenter.org/sites/default/files/legacy/files/Ensuring%20Strategic%20Stability%20by%20A.%20 Kokoshin.pdf.

99. Ibid, 35. This implies that this is at least one form of thinking by Russian officials' on strategic stability.

100. A.I. Antonov, Speaking Notes, Security and Disarmament Department, Russian Ministry of Foreign Affairs NATO-Russia Council Meeting, October 17, 2007, as referenced in Eugene Miasnikov, "On the Relationship Between Nuclear and Conventional Strategic Arms in the New START Treaty," Armscontrol.ru, September 10, 2010, https://www.armscontrol.ru/pubs/en/em091010.pdf.

101. Ibid.

102. Dvorkin, "Hypersonic Threats." This topic is fiercely debated in Russian open-source expert discourse.

103. Kokoshin, "Ensuring Strategic Stability," 13-14, 17, 36-37. U.S. leaders did concluded in 1969 that the U.S. could not attain strategic predominance over the Soviet Union over the following decade.

104. Vitaly Katayev, "Soviet Programs for Countering Missile Defenses," (*Sovetskie Programmi Protivodeystvia PRO*), as referenced in Podvig, "Document Details Soviet Response to the Star Wars Missile Defense Program." For Russian arguments against specific missile defense installations in Europe, see Keir Giles and Andrew Monaghan, "European Missile Defense and Russia," Strategic Studies Institute, July 2014, https://ssi.armywarcollege.edu/pdffiles/PUB1219.pdf.

105. Podvig, "Avangard System is Tested, Said to be Fully Ready for Deployment."

106. Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), May 26, 1972, preambular paragraph 2, https://2009-2017.state.gov/t/avc/trty/101888.htm#:~:text=Treaty%20Between%20The%20United%20States,Ballistic%20Missile%20Systems%20(ABM%20Treaty)&text=The%20Treaty%20permits%20each%20side,protect%20an%20 ICBM%20launch%20area; see also Kokoshin'sreferences to U.S. Secretary of Defense Robert McNamara's explanation that a belief by both sides that one could be shielded from a retaliatory second strike by a national ballistic missile defense system could lead to much faster crisis escalation than if that belief were not in place. Kokoshin, "Ensuring Strategic Stability," 13.

107. Kokoshin, "Ensuring Strategic Stability," 14; ABM Treaty, preambular paragraphs 2-3, http://www.nti.org/media/pdfs/aptabm.pdf?_=1316631917&_=1316631917; Soviet-United States Statement on Future Negotiations on Nuclear and Space Arms and Further Enhancing Strategic Stability, June 1, 1990, http://www.presidency.ucsb.edu/ws/?pid=18541.

108. Vladimir Putin, "Russia Will Develop Its Air-Space Defense Capabilities," (*Rossiya Budet Narashchivat' Vozmozhnosti VKO*),*National Defense*, No. 7 (July 2013): 22, as referenced in Arbatov, "Strategic Dialogue," and Acton, *Silver Bullet?* 104.

109. Sokov, 47.

110. Dmitry Adamsky, "Cross Domain Coercion," 25-26. See also Sergei Chekinov, and Sergei Bogdanov, "Asymmetric actions in accordance with the military security of Russia," (*Assymetrichnye deistvia po obespecheniyu voennoy bezopasnosti Rossii*),*Voennaya Mysl*,no. 3, 2010, 13-22, http://militaryarticle.ru/voennaya-mysl/2010-vm/10291-asimmetrichnye-dejstvija-po-obespecheniju-voennoj.

111. Nikolai Sokov, "New START Ratification in Russia," James Martin Center for Nonproliferation Studies, January 25, 2011, http://www.nonproliferation.org/new-start-ratification-in-russia/; "Communist Party Proposes to Adopt a Statement on National Security Together with START III," (*KPRF Predlagaet Vmeste s SNV-3 Prinyat Postanovlenie o Natsbezopasnosti*), *RIA-Novosti*, January 12, 2011, https://ria.ru/defense_safety/20110112/320624197.html.

112. Sokov, "New START Ratification in Russia."

113. "The Military Doctrine of the Russian Federation," June 29, 2015, paragraph 8(m).

114. Strategic deterrence is defined as: "A coordinated system of military and non-military (political, diplomatic, legal, economic, ideological, scientific-technical and others) measures taken consecutively or simultaneously … with the goal of deterring military action entailing damage of a strategic character … [It] is directed at the stabilisation of the military-political situation … in order to influence an adversary within a predetermined framework, or for the de-escalation of military conflict ..." Military-Encyclopaedic Dictionary of the Russian Ministry of Defense, "Deterrence Strategic," (*Cderzhivanit strategicheskoe)*, http://encyclopedia.mil.ru/encyclopedia/dictionary/details.htm?id=14206@morfDictionary; as referenced and translated in Kristin Ven Bruusgaard, "Russian Strategic Deterrence,"*Survival*, 58:4, July 19, 2016. "[…] when taking military action, strategic deterrence relies mainly on Russia's nuclear forces and Strategic Rocket Forces. During the initiation, development and resolution of inter-state…conflicts…strategic deterrence is usually implemented as a coordinated effort of non-military and military measures in different spheres of state activity" and relies on "military force with necessary adherence to two fundamental principles: adequacy of reaction and

the non-provocation of a threat or aggression." "Deterrence Strategic."

115. Meeting of the Valdai International Discussion Club, President of Russia, October 22, 2015, http://en.kremlin.ru/events/president/news/50548, as referenced in Acton ed., Arbatov et al., "Entanglement," 24.

116. Yevgeny Miasnikov, "High-precision Conventional Weapons," (*Visokotochnoe obichnoe oruzhie*) in Alexey Arbatov and Vladimir Dvorkin ed., *Nuclear Reset: Arms Reduction and Nonproliferation* (*Yadernaya perezagruzka: sokrashenie inerasprostranenie vooruzhenii*), (Carnegie Moscow Center: Moscow, 2011) 420, http://carnegieendowment.org/files/Nuclear_reset_2011.pdf.

117. Aleksandr Khramchikhin,"Weakness Provokes More than Might" (*Slabost provotsiruyet silneye chem moshe*),*Nezavisimoe Voennoe Obozreniye*, 19 March 2010, http://nvo.ng.ru/concepts/2010-03-19/1_weakness.html; Dvorkin, "Hypersonic Threats"; Dmitry Akhmerov, Yevgeny Akhmerov, and Marat Valeev, "It Won't Happen Fast," (Po-bystromu ne poluchitsya),*Voenno-promyshlennyi kurer*, October 21, 2015 ,https://vpk-news.ru/articles/27617 as referenced in James M. Acton ed., Alexey Arbatov et al., "Entangement: Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks," Carnegie Endowment for International Peace, 2017, http://carnegieendowment.org/files/Entanglement_interior_FNL.pdf.

118. V.V. Alferov and V.I. Polegaev, "On Non-Nuclear Deterrence, It's Role and Place in the Strategic Deterrence System," (*O neyadernom sderzhivanie, evo roli i meste v systeme strategicheskovo sderzhivania*), *Voennaya Mysl*, http://vm.milportal.ru/o-neyadernom-sderzhivanii-ego-roli-i-meste-v-sisteme-strategicheskogo-sderzhivaniya/.

119. "Production of Ballistic Missiles Lags Behind Schedule," (*Proizvodstvo ballisticheskikh raket otstayot ot grafika*), *Independent Military Review*, http://nvo.ng.ru/%20armament/2017-01-27/2_934_red.html.

120. Speech of the Chief of the Russian Federation Armed Forces General Staff—First Russian Federation Deputy Defense Minister, Army General Valeriy Gerasimov at the Public Meeting of the Defense Ministry Collegium; "The Creation of the 'Iskander-M' Zone in the Kaliningrad Region Has Been Completed,"*Ria Novosti*, Januray 31, 2018, https://ria.ru/defense_safety/20180131/1513691588.html.

121. Kokoshin, "Ensuring Strategic Stability," 57-58.

122. Ibid, 57.

123. Meeting of the Valdai International Discussion Club, October 24, 2014, http://en.kremlin.ru/events/president/news/46860, as referenced inActon ed., Arbatov et al., "Entanglement," 26.

124. Speech of the Chief of the Russian Federation Armed Forces General Staff—First Russian Federation Deputy Defense Minister, Army General Valeriy Gerasimov at the Public Meeting of the Defense Ministry Collegium.

125. Pavel Podvig, Igor Sutyagin, and Boris Zhelezov, "The Structure and Operations of Strategic Nuclear Forces" in Pavel Podvig ed., *Russian Strategic Nuclear Forces*, (Cambridge: MIT Press, 2001), 49.

126. Ibid, 45-49; "Presidential Commissions," President of Russia, accessed January 7, 2018, http://en.kremlin.ru/structure/commissions#institution-41.

127. "Presidential Commissions."

128. "Gala Evening Marking 60 Years of the Military-Industrial Commission," President of Russia, December 14, 2017, http://en.kremlin.ru/events/councils/by-council/41/56380; "History of the MIC," (*Istoria VPK*), MIC Feed, last updated 2014, http://www.oborona.gov.ru/vpk/history; "Meeting on Drafting the 2016-2025 State Armament Programme," President of Russia, last updated September 10, 2014, http://en.kremlin.ru/events/councils/by-council/41/46589.

129. Podvig et al., "The Structure and Operations of Strategic Nuclear Forces," 49.

130. "Gala Evening Marking 60 Years of the Military-Industrial Commission."

131. Russia defines "military policy" as "the activities of the State aimed at organizing and conducting defence and maintaining the security of the Russian Federation as well as the interests of its allies." The Military Doctrine of the Russian Federation, Februay 5, 2010, paragraph 8(и); "The Military Doctrine of the Russian Federation," June 29, 2015, paragraphs 8(i) and 17.

132. According to the Russian law "On the State Defense Order," (*O Gosudarstvennom Oboronnom Zakaze*), the state consumer is a "federal organ of the executive branch or the Rosatom Atomic Energy State Corporation" and "ensures the supply of products in accordance with the State Defense Order." See Article 3(2), http://www.scrf.gov.ru/security/military/document125/.

133. "Composition of the Russian Federation Military Industrial Commission Collegium in revision of the Government order from 23 January 2019 No55-r," (*Sostavkollegii Voenno-promishlennoy komissii Rossiiskoy Federatsii v redaktsii rasporyazhenia Pravitelstva ot 23 yinvarya 2019 goda No55-r*), The Government of Russia, http://government.ru/info/35475/. Dmitry Rogozin served this post until recently. See "Collegium of the Russian Federation Military-Industrial Commission," Government of Russia, accessed February 3, 2018, http://government.ru/department/300/about/.

134. "Composition of the Russian Federation Military Industrial Commission Collegium in revision of the Government order from 23 January 2019 No55-r"; "Commission Composition," (*Sostav Comissii*), Military-Industrial Commission Collegium, last updated October 10, 2014, http://www.oborona.gov.ru/vpk/members1; Presidential Decrees 628, 49, 319, 25, 334, and 495, The Government of Russia, http://government.ru/department/300/members/.

135. "Composition of the Russian Federation Military Industrial Commission Collegium in revision of the Government order from 23 January 2019 No55-r."

136. "About the Corporation"; JSC Tactical Missiles Corporation, Yearly Report for 2011, 7, http://www.ktrv.ru/about/raskrytie-informatsii/finansovye-otchety/.

137. See Podvig et al., "The Structure and Operations of Strategic Nuclear Forces." Sokov explains how in general such decisions were heavily influenced by the Politburo, since it gave responsibility to certain actors to make a given defense decision. See Sokov,*Russian Strategic Modernization*, 22.

138. "Meeting on Drafting the 2016-2025 State Armament Programme."

139. "The Military Doctrine of the Russian Federation," June 29, 2015, paragraphs 5, 18,and 52.

140. "Tactical Missiles Corporation," (*Korporatsia Takticheskoe Raketnoe Vooruzhenie*), *RBK*, https://www.rbc.ru/companies/id/467; "'How to Not Lose the Missile War,' – Boris Obnosov, Tactical Missiles Corporation General Director," (*'Kak ne Proigrat Raketnuyu Voinu,' – Boris Obnosov, Gendirektor Korporatsii 'Takticheskoe Raketnoe Vooruzhenie'*), *Vedomosti*, September 25, 2007, https://www.vedomosti.ru/newspaper/articles/2007/09/25/kak-ne-proigrat-raketnuyu-vojnu---boris-obnosov-gendirektor- korporacii-takticheskoe-raketnoe-vooruzhenie.

141. See for example "Meeting on Drafting the 2016-2025 State Armament Programme."

142. "Composition of the Russian Federation Military Industrial Commission Collegium in revision of the Government order from 23 January 2019 No55-r."; "History of the MIC"; Presidential Decrees 628, 49, 319, 25, 334, and 495.

143. "Meeting on Drafting the 2016-2025 State Armament Programme."

144. "In Russia Work is Underway to Build Hypersonic Weapons," (*V Rossii vedutsya rabotiy po sozdaniyu giperzvukovovo oruzhiya*), *RIA Novosti*, April 23, 2013, https://ria.ru/20130423/934037911.html.

145. "About Corporation," (*O korporatsii*), JSC Tactical Missile Corporation, http://eng.ktrv.ru/about/;

"General Director of KTRV Boris Obnosov: 'The First Hypersonic Aircraft will Arise at the Beginning of the Next Decade" (*Gendirektor KTRV Boris Obnosov: 'Pervie Giperzvukovie Letatelnie Apparati Poyavyatsa v Nachale Sleduyushevo Desyatiletiya'*), *Interfax-AVN*, http://militarynews.ru/story.asp?rid=2&nid=439291.

146. Obnosov was noted as explaining at the 2013 Moscow Air Show that creating such vehicles takes the creation of new types of materials, technologies, and engines, and requires the uniting of "a large amount of production enterprises." "Russian Scientists Were Told to Creat a Hypersonic Aircraft," (*Rossiskim Uchyonim Poruchili Sozdat Giperzvukovoy Letatelniy Apparat*), *Interfax*, May 3, 2017, http://www.interfax.ru/russia/560994.

147. Zudin, "Russia to Draft Hypersonic Missile Programme in Mid-2013"; "Russian Scientists Were Told to Create a Hypersonic Aircraft."

148. Sokov, *Russian Strategic Modernization*, 4.

149.]Vladimir Putin, "Being Strong: National Security Guarantees for Russia,"*Rossiyskaya Gazeta,*February 20, 2012, http://archive.premier.gov.ru/eng/events/news/18185/.

150. Acton ed., Arbatov et al., "Entanglement," 24.

151. Akhmerov, Akhmerov, and Valeev, "It Won't Happen Fast."

152. Ibid.

153. Their decrease is likely due to the presence of more money for allocation to defense budgets.

154. "Meeting with Workers of the Kalashnikov Company," (*Vstrecha s Rabochimi Kontserna "Kalashnikov"*), President of Russia, September 20, 2016 ,http://www.kremlin.ru/events/president/news/52921 as referenced in Mathieu Boulègue, "Russia's New State Armament Programme Offers a Glimpse at Military Priorities," Chathem House, November 27, 2017, https://www.chathamhouse.org/expert/comment/russia-s-new-state-armament-programme-offers-glimpse-military- priorities.

155. Stephen Foye, "Parliamentary Hearings on 1995 Defense Budget,"*RFE/RL*, no. 140, July 26, 1994, http://www.friends-partners.org/friends/news/omri/1994/07/940726.html (opt,mozilla,mac,english,,new); Stephen Foye, "Parliament Defies Government on Defense Budget,"*RFE/RL*, no. 135, July 19, 1993, http://www.friends-partners.org/friends/news/omri/1993/07/930719.html (opt,mozilla,mac,english,,new).

156. Sokov,*Russian Strategic Modernization,*10, 21, 27.

157. U.S. Senate, *Treaty With Russia on Measures for Further Reduction and Limitation of Strategic Offensive Arms (*The New START Treaty), Report, EXEC. REPT. 111-6, 111th Cong., 2nd sess. (October 1, 2010), 51-52, https://www.foreign.senate.gov/imo/media/doc/CRPT-111erpt6.pdf, as referenced in Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles," 41, and Acton,*Silver Bullet*, 139. See also 55 specifically, and 51-57.

160. "Address of the President to the Federal Assembly," March 1, 2018.

161. Gerasimov, "According to the Syrian Experience."

Pakistan's Space Program: From Sounding Rockets to Satellite Setbacks

Dr. Sannia Abdullah*

Why did Pakistan struggle for 50 years to launch its satellites into Earth's orbit when it was Asia's third country to send sounding rockets into space? Four years ago, India launched 104 satellites from a single rocket to set a groundbreaking record,[1] whereas Pakistan launched only six satellites with assistance in the design, built, launch, and even funding from China.[2] Pakistan plans to send its first astronaut into space by 2022;[3] India put its first astronaut into "space in 1984 as part of a Soviet-led mission."[4] Despite a good head-start, why is Pakistan's space program decades behind when India's space expedition started eight years later? The literature on Pakistan's space program suggests that the country's staggering space performance is because SUPARCO (Pakistan's national space agency) was "denied the funding and resources needed to ensure a sustained rate of advancement and innovation."[5] Some scholars argue that the commission was neglected because of "bureaucratic hurdles, and mismanagement,"[6] while others believe that "the political turmoil which enveloped the country"[7] for decades caused inadvertent delays. However, the fundamental reason behind Pakistan's inadequate space performance in Asia's space race is the lack of technical expertise to harness indigenous space capabilities. The commission over the years relied on a handful of foreign-trained scientists and engineers, imported technology for quick fixes, and used foreign launch facilities to keep its head above water. These temporary arrangements rang the nonproliferation bells, and in 1991 SUPARCO faced"technological denial"[8] from the West under sanctions. As a result, the satellites missed deadlines to join the designated orbital slots. This added a financial burden to the debt-trap economy of the country, and the vicious circle was hard to break for decades. After the 1998 nuclear tests and the subsequent military coup (8 October, 1999), SUPARCO among other strategic organizations came under the umbrella institution of the Strategic Plans Division (SPD). Since then, it has been operating under military officers, unlike India's ISRO, which is guided by scientists who lead the agency with task-oriented missions. To spearhead the space-race against India, SUPARCO is circumventing the natural learning curve of research and development under military leadership that observes strict hierarchy within the commission. Seniority supersedes talent, thus making the institution a less attractive career choice for young graduates. This paper address three important questions: First, what are the factors behind SUPARCO's snail's pace? Second, why does Pakistan not have a satellite launch vehicle (SLV), needed to launch satellites into Earth's orbit, when it has already mastered the ballistic missile program? Both SLV and ballistic missiles are very similar technologies. Third, what measures can improve Pakistan's space program?

The Space Flight and Path of Technology Import

SUPARCO was founded in the space age, when the Soviet Union shocked the world with the successful launch of the first artificial Earth satellite (Sputnik-1) on 4 October, 1957. The United States, triggered by space developments, started the Apollo mission to make the first human landing on the moon. To accomplish the mission, the U.S. space agency - National Aeronautics and Space Administration (NASA) - needed necessary information on the wind structure of the upper atmosphere and sought cooperation with Indian Ocean littoral states for establishing rocket ranges to collect data. This opportunity brought two space agencies, NASA and SUPARCO, closer. Prof. Abdus Salam[9] (the Pakistani Nobel laureate) and his team[10] met NASA officials and seized the offer. In June 1962, the United States launched two U.S. rocket motors, the Nike and the Cajun, from Sonmiani Beach (Karachi-Pakistan). The rocket reached an altitude of almost 130 kilometers. NASA hailed the launch as the beginning of a program of continuing cooperation in space research of mutual interest."[11] Just a few days later, on 7 and 11 June, 1962, Pakistan launched two sounding rockets, Rehbar-I and Rehbar-II, using NASA's launch facility at Somniani, thus making Pakistan Asia's third country for shooting rockets in space.[12] Even though Pakistan's development of two-stage solid-fuel rockets marked a huge achievement of the time, it is not a coincidence that Rehbars are technologically identical to NASA's Nike-Cajun/Nike-Apache rockets. Both rockets not only look similar but carried almost the same payload of 80 pounds and reached the same altitude of 130 kilometers in the atmosphere, like Nike-Cajun/Nike-Apache. It is fair to assume that Rehbars are Nike-Cajun/Apache. The systems have the same length and diameter (See Figures 1A and 1B). The evidence further suggests that Rehbars provided Pakistani scientists with the same information on wind shear and layers of the upper atmosphere outside the stratosphere[13] as was needed for the Apollo mission. SUPARCO's official website admits that "Rehbar-I consisting of a Nike-Cajun combination (which was earlier developed by NASA) was successfully launched from Sonmiani Rocket Range."[14] Thus, the "honor of becoming the third country in Asia and the tenth in the world to conduct such a launching"[15] was not a feather in SUPARCO's cap.

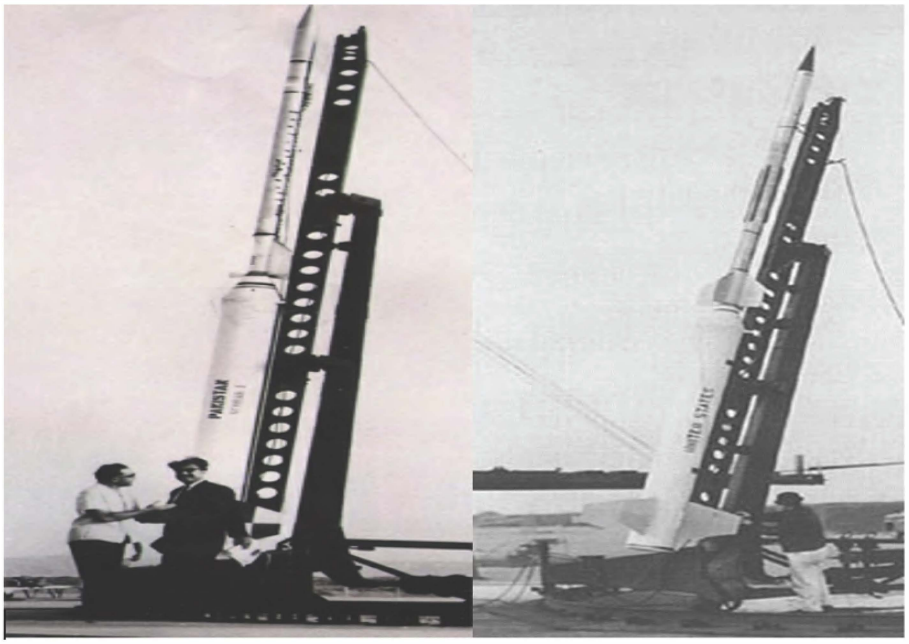

Image 1A (Rehbar-1) **Image 1B (Nike-Cajun)**

Source: Image 1A shared by @AwaisBajwa; Image1B at https://history.nasa.gov/SP-4402/ch5.htm

After launching the sounding rockets, the path for short-range ballistic missiles would have been much easier; however, SUPARCO faced several hurdles in developing short-range systems. The Hatf missiles did not come into public awareness until 6 February, 1989,when Pakistan's then Army Chief Gen. Mirza Aslam Beg at National Defence College announced the development of "Two indigenously manufactured surface-to-surface missiles Hatf-1 and Hatf-2," and also asserted that the "guidance system used in missiles [was] extremely accurate and developed in Pakistan."[16] Hatf was a surface-to-surface short-range system with "no in-flight guidance as evidenced by the long launch ramp that accompanies it."[17] It could "theoretically carry a tactical nuclear weapon", although Pakistan declared it non-nuclear.[18] Pakistan claimed Hatf systems were "indigenous" and a modification of French-sounding rockets, the single-stage Dauphin or two-stage Eridan.[19] Some experts who believe that Hatfs are Chinese systems are not wrong. Pakistan's then foreign minister, Abdul Sattar, on 26 August, 1993, stated in the Pakistan Senate, "These missiles [HATF] were bought keeping in mind Pakistan's security needs."[20] Some U.S. officials questioned the accuracy of Hatf-1 and Hatf -2 systems and claimed, "The Hatf-1 is an inaccurate battlefield rocket that can fly 80 kilometers…the Hatf-2 is just two Hatf-1s put together."[21] The flight range of 300 kilometers was exaggerated and "Neither missile is a very high-tech product."[22] The status of Hatf-1 and 2 systems remained unclear on serial production and deployment in public knowledge. In 1995, the Hatf-1A replaced the Haft-1 and

Hatf-1B replaced Hatf-2 in 2001 with an improved range (~80 kilometers) and accuracy. The need for improved versions validates the U.S. officials' claims that Hatfs were not as stable and efficient systems as projected by Pakistani authorities. In 2011, Pakistan tested another short-range/battlefield surface-to-surface ballistic missile, Nasr (Hatf-IX -60-kilometer range).[23] Nasr is a nuclear-deliverable solid fuel, single-stage rocket developed by National Defense Complex and already inducted by the Pakistan army. If Hatfs were efficient systems, Pakistan's missile inventory wouldn't need another short-range system like Nasr. Apart from Hatf-1 and 2, Pakistan's track record with other Hatf systems around that time was not satisfactory either. In the mid-1990s, A.Q. Khan (head of KRL) traveled 13 times to North Korea to "receive technical assistance for the development of the Ghauri missile, an adaptation of the North Korean No Dong design."[24] The initial test of the Ghauri missile failed, and the debris fell into Iran because the nose cone burned upon re-entry because of hypersonic effects and high-temperature shifts. The new system had to replace the engine and propellent, and the nose cone had to redesigned.

The Satellite Setbacks

Since the beginning, SUPARCO has faced technological setbacks in manufacturing satellites and launching them into Earth's orbit. In 1992, after the success of the Badr-1[25] satellite, SUPARCO concentrated its efforts on Badr-B, a cube-shaped Earth observation satellite made of "space-qualified aluminum T-6 alloy,"[26] equipped with "several CCD cameras, compact dosimeter, a telemetry system, charge detector, and a temperature control unit."[27] The CCD camera is a sophisticated technology used for remote sensing.[28] Pakistan contacted Rutherford Appleton Laboratory (RAL) for assistance in CCD cameras.[29] The satellite completion took longer than its due date, leading Pakistan to miss its orbital entry slot for the planned launch in 1994. The commission contacted China and Russia for the lowest rates of launch. The cooperation with Russia further delayed the launch by four years, frustrating the scientific community in Pakistan. After missing four chances, SUPARCO launched communication satellites to keep the geostationary orbital slot in space.[30]

Until now, SUPARCO has indigenously built only two experimental satellites, the Badr-1 and PakTES-1A. The PakSAT-1R and PRSS-1 were made in China and sold to Pakistan. In December 2001, Pakistan leased the US HG3, "Originally launched as Indonesia's Palapa C1 and later sold to Turkey [Anatolia 1] - and renamed it PakSAT-1."[31] Pakistan moved this satellite from Turkey's orbital slot to Pakistan's slot.[32] It was a geosynchronous and communication satellite built by the Boeing Company (Hughes).[33] Around 2004, scientists planned to launch the satellite using a Shaheen-III booster from an unknown facility in Pakistan. However, in October 2008, Pakistan contacted China to buy Chinese satellite PakSAT-1R and sought launch service and a platform. Pakistan's economy was so weak that China provided Pakistan a soft loan of 1.35 billion RMB (around US$200 million), with a maturity

period of 20 years for the satellite. On 11 August, 2011, PakSAT-1R was launched from China and replaced PakSAT-1. After seven years, (9 July, 2018), Pakistan launched its two remote sensing satellites, PRSS-1 and PakTES-1A, from China's Jiuquan Satellite Launch Center using Long March-2C rocket.[34] PRSS-1 is an optical remote sensing and Earth observational satellite, again purchased from China,[35] and is part of Sino-Pak space cooperation that will enhance cooperation in climate change, disaster management, risk reduction, and other areas of mutual interest.[36] However, because satellites are dual-use systems, the military implications are ripe for speculation. PRSS-1 has spatial resolutions as fine as 1 meter in panchromatic mode and 4 meters in multispectral mode. Such features characterize "high geometric precision, short revisit intervals, and rapid data supply. Such imagery will provide greater spatial details on the land surface and open new applications relevant to social sciences."[37] China's stated aim of the PRSS-1 is to monitor the progress of the China-Pakistan Economic Corridor (CPEC) project in Pakistan. The satellite's sophisticated technology will "carry out day and night monitoring, and it has viewing capacity even in clouded conditions."[38] The other satellite, PakTES-1A, indigenously built by SUPARCO engineers, was co-launched with PRSS-1.[39] The table below outlines the details of Pakistani satellites type, features, life span, launching facility, and launch locations.

Satellite Name	*Launch/Entry into Orbit Date*	*Location*	*Launcher*	*Satellite Type*	*Built/Manufactured*	*Life Span*
Badr-1 *150KG*	July 16, 1990	Xi Chang Station (China)	Long March 2E Rocket	Experimental Artificial satellite	Jointly built by SUPARCO and CNSA	One month
Badr-B *68KG/ALT:986 KM*	December 10, 2001	Baikonur Cosmodrome-Kazakhstan	Zenit-2 Rocket	Earth observational Satellite	UK- Space Innovations Limited & Rutherford Appleton Labs	2 years
PakSAT-1 *3000KG/ALT:35,400KM*	December 20, 2002.	Moved from previous orbit to Pakistan's orbital slot	—	Geosynchronous Communication Satellite	The Boeing Company Leased by Pakistan from US Hughes	~10 years
PakSAT-1R *5200KG/ATL: 35,700KM*	August 11, 2011	Xi Chang Station (China)	Long March 3B	Geosynchronous, Communication Satellite	Great Wall Industry Corporation (China)	12-15 years
PRSS-1 *1200KG/ATL: 640KM*	July 09, 2018	China's Jiuquan Satellite Launch Center (China)	Long March 2C Rocket	Optical Remote Sensing & Earth Observational Satellite	China Academy of Space Technology (CAST) - Sold to Pakistan	6-8 years
PakTES-1A *300KG/ALT: 610KM*	July 09, 2018	China's Jiuquan Satellite	Long March 2C Rocket	Experimental Satellite	Built by SUPARCO	—

Source: Data collected by the author from different sources

Quest for a Satellite Launch Vehicle (SLV)

For years, SUPARCO has used China's expertise and launch facilities for its satellites."Pakistan is currently on the list of those countries which lack launching facility."[40] Most of the payloads are launched in space using expendable launch vehicles (ELV).[41] ELVs are relatively less costly because they use disposable components for the launch and hence, they are not reusable. In 1999, SUPARCO's former chairman announced that "Pakistan would develop its satellite launching vehicle within a period of about three years."[42] So why could Pakistan not develop its SLV? Shahid Qureshi, head of the Institute of Space and Planetary Astrophysics, also wondered, "If we can launch a [IRBM] missile up to a range of 1,500km, why not build an SLV that can launch low-atmosphere satellites?"[43] However, many within SUPARCO believe"SLVs involve complex technology and are beyond what Pakistan can do on its own."[44] As per the latest public information, "Pakistan has already completed three of the four stages of its SLV."[45]

The commission has long been trying to develop a low-cost rocket booster[46] to launch lightweight satellites into low-Earth orbits (LEO). In the early 2000s, Pakistan started a design study on two SLVs presented in the IDEAS 2002 defense exhibition. The first design points to the three-stage model of SLV having a"lengthened common core booster without the strap on" and the other design uses "four strap-on boosters attached to the common core."[47] Both designs were higher modifications of Shaheen-I/M11 and Shaheen-II/M-18 systems with an upgrading and changes in solid motors to increase the thrust of the booster of Shaheen systems.[48] Instead of SLV, these designs led to the development of the Shaheen-III multi-stage solid-fuel surface-to-surface ballistic missile, test-fired on 9 March, 2015, having a 2,750-kilometer range[49] and jointly designed by NESCOM and SUPARCO. Shaheen-III's test showed a strike role to cover the strategic targets of the Nicobar and Andaman islands in the Indian Ocean, coming in response to India's Agni III.[50] The hindsight purpose of Shaheen-III, however, was the gradual upgrading of Shaheen systems using existing expertise and hardware towards the development of a satellite launch vehicle. Two years later (24 January, 2017), Pakistan tested, Ababeel, a surface-to-surface medium-range ballistic missile capable of carrying multiple payloads. It is a multiple independently targetable reentry vehicle (MIRV).[51] As seen in Image 2, Ababeel is an improved version of the Shaheen-III system, with a third stage added. Pakistan's Ababeel has significant

similarities to the Chinese KuaiZhou KZ-1A system, except KZ-1A is a "four-stage rocket, using solid rocket engines on the first-, second-, and third-stage, and a liquid fourth-stage which is also the payload."[52] The nose cone ofAbabeel is bigger than that of Shaheen-III and is designed for multiple payloads. Ababeel could probably be used for space launch to transport multiple payloads into space at one time, just as India did. Taimoor, as shown in the Image 2, could be an ICBM still in the manufacturing phase.

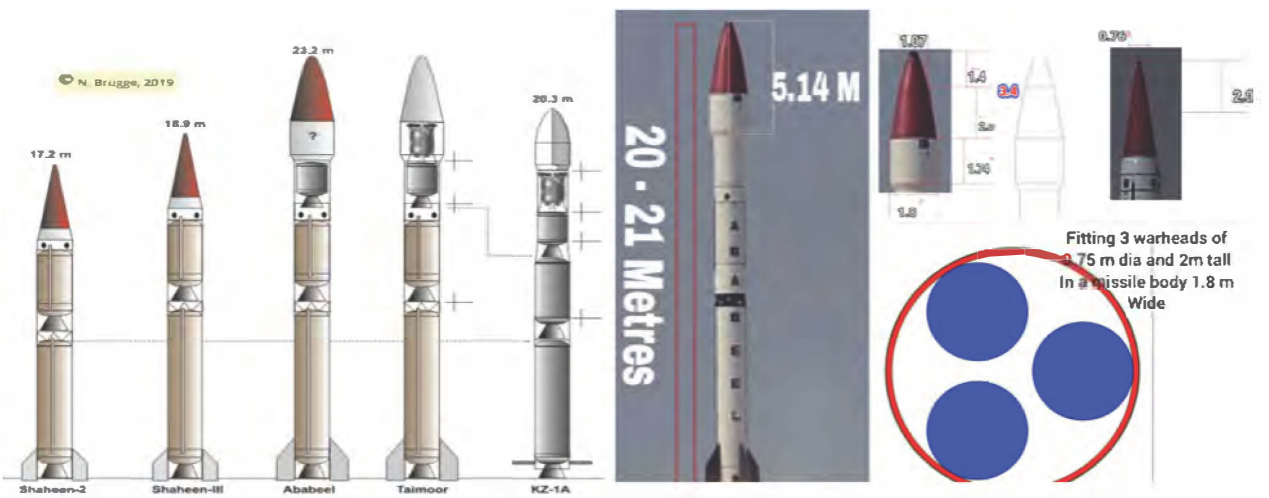

Image 2
Source:http://www.b14643.de/Spacerockets_1/Rest_World/Taimoor/Versions/Taimoor.jpg

Ababeel will be transported through a transporter erector launcher (TEL) vehicle to the launch site within hours, instead of weeks of preparation. Pakistan's national parade images reveal Shaheen-III on TEL, which is longer to accommodate the missile. The image below shows that this TEL is for a bigger system like Ababeel. Now when the need for the satellite launch vehicle seems to have been resolved, there are several other challenges for SUPARCO to advance the country's space program.

Image 3

Source: Image from Inter Services Public Relations (ISPR) - Pakistan

Insufficient Space Knowledge and Expertise

The need for foreign assistance in satellite developments is Pakistan's dearth of trained professionals and weak economy as presented by the Pakistan Aqkan situation. The scientific education program requires special attention, particularly in the disciplines of applied sciences and space studies. There are only a handful of universities "offering aeronautical engineering degrees and there are yet fewer institutes committed to scientific research and development."[53] SUPARCO is currently hiring graduates from two major institutions, the Institute of Space Technology (IST) and the National University of Sciences and Technology (NUST). The IST offers engineering in space sciences, electrical, mechanical, material sciences, avionics, aerospace, and satellite engineering. Some Ph.D. programs operate in collaboration with Chinese universities.[54] NUST offers aerospace engineering, avionics, and aeronautical engineering. Interestingly, within the space research lab of NUST, most of the faculty received training from the Pakistan Air Force Academy at Risalpur.[55] Other educational institutions include Air University, Karachi University, and the University of Punjab. Karachi University offers graduation in Space Science and Technology and has a long association with SUPARCO. The University of Punjab has departments of metallurgy and materials engineering, electrical, and polymer engineering and technology with a focus on emerging technologies. Some faculty members are foreign qualified with Ph.D.s from the UK, New Zealand, and Australia.[56] The Air University offers a bachelor's degree and Ph.D. in electrical, mechanical, mechatronics, avionics, and aerospace engineering. Pakistan has only one university in the country that currently offers a Masters in Applied and

Computational Mathematics; however, no university is offering education on optical physics. SUPARCO's former chairman, Maj. Gen. Ahmed Bilal, also mentioned that "At a base level, two major disciplines in HR are lacking in Pakistan: i) Applied Mathematics, ii) Optical Physics."[57]

Instead of creating universities to improve scientific education, Pakistan has been relying on foreign training programs/scholarships. In the early 1960s, the NASA-SUPARCO cooperation agreement trained Pakistani scientists and technicians at NASA space science centers. This practice continued and Pakistan sent over 500 scientists to the United States.[58] Most of them returned home to work for Pakistan's nuclear and missile program. The second generation of scientists received training in the 1980s when SUPARCO sent hundreds of engineers to the University of Surrey (England) in the development of UO-11, launched in 1984. From the year 2000 onwards,"A very large number of young engineers and scientists were sent to foreign universities in the USA, the UK, France, the Netherlands, Germany, Sweden, China, and South Korea under the HEC-funded programs and from SUPARCO's budget."[59] The commission also seeks cooperation with other space organizations such as the Office of Outer Space Affairs of UNO in Vienna, Asia-Pacific Space Cooperation Organization, Inter-Islamic Network on Space Science and Technology for training. It's not publicly known how many engineers/scientists return home after completing the training programs. Air Cdr. Arshad Siraj mentioned to the author that there were many returning scholars in the beginning, but they tapered off in the following years.[60] Pakistan's current government expedited some initiatives to prioritize the space program. In 2018, four major centers of excellence were created to augment space and allied sciences programs. These include the National Centre of Artificial Intelligence[61], the National Centre of Robotics and Automation[62], the National Centre for Cyber Security, and the National Centre of Big Data and Cloud Computing. These institutions are formed with "the mission of accelerating technological development through scaling up the availability of the scientific community to advance the national space and allied science programs."[63] Apart from technical education, SUPARCO needs high-quality research to apply knowledge to create a product line that requires separate resource allocation in the national budget.

Economic Challenges

Pakistan's weak economic base delays SUPARCO's performance output. Pakistan has a "semi-industrialized economy that relies on manufacturing, agriculture, and remittances."[64] As of July 2019, Pakistan's GDP is 5.79%, which is not good for the fast-growing population. According to the World Bank, Pakistan's current account deficit (CAD) in FY 2018 reached 6.1 from 4.1 of FY 2017.[65] The economic trends of this year are more worrisome with the growth rate declining from 6.1% to 3.3% in FY 2019 and is likely to go down to 2.4% by next year.[66] Pakistan signed another

bailout package with the International Monetary Fund (IMF) of $6 billion. As of FY 2018-2019, the country's defense budget makes up a fifth of the government's total spending, estimated to be around $8.5 billion.[67] Given the current "critical financial situation", the Pakistan military froze its defense budget, calling it "a voluntary cut."[68] However, despite this arrangement, "the federal government hand over more than half its budget to the provinces and the rest is mostly eaten up by debt servicing and the military's vast budget."[69] The current economic outlook poses more serious challenges to the space program even though the government promised that "SUPARCO will receive a budget of just more than $40 million for fiscal 2018-2019."[70] The debt has already ballooned over "Rs33 trillion, and an ambitious space program will likely pop this balloon."[71] Despite functional prototypes, Pakistan does not have the technology for satellites because of the associated expense. The next thought is whether China would help Pakistan.

On 29 April, 2019, Pakistan and China signed a space agreement aiming to "conduct scientific and technological experiments, astronaut training, along with manned space applications and achievement transformation."[72] The federal minister for Science and Technology, Fawad Chaudhry, said, "China is Pakistan's natural entryway into space…"[73] But there are concerns about space ambitions. For instance, according to the Pentagon,"China's satellite launches are ominous."[74] China's military"continues to strengthen its military space capabilities despite its public stance against the militarization of space" including the BeiDou navigation system and new weaponry.[75] Although seen suspiciously in the West," China and Pakistan have enjoyed over 20 years of cooperation in Space Science, Technology and Applications."[76] China's space competition with the United States and India will benefit Pakistan in expediting its space endeavors as China is the best bet for Pakistan, which will share technology on soft loans. The greatest challenge here is the nonproliferation regime.

The MTCR and Space Cooperation

Under the Missile Technology Control Regime (MTCR), transferring missile-related technology hardware or knowledge or component that contributes to the development of missiles capable of carrying 500 kilograms of a payload a distance of 300 kilometers or more is strictly forbidden. Pakistan and China are not members of MTCR. Although China applied for membership in 2004, the members shared concerns about China's past export control policies, particularly regarding technology transfers to Pakistan and Saudi Arabia. Pakistan has not applied for MTCR membership yet. The catch for non-members is that ultimately the non-nuclear weapons states will have to give up their ballistic missiles capable of carrying a payload of 500 kilograms over 300 kilometers or more. Pakistan is not alone in benefitting from overseas' help with technology; India's space agency (ISRO) received missile technology, including "several cryogenic upper stages along

with the production technology," from Russia, while U.S. satellite transfers to China in 1993 later raised proliferation concerns.[77] SUPARCO became victim to non-proliferation sanctions for technology reliance. These sanctions time to time affected SUPARCO's performance. For instance, in June 1991 the Bush administration levied missile sanctions on SUPARCO under the Arms Export Controls Act and the Export Administration Act of 1979.[78] In 1994, China agreed to facilitate Pakistan in providing soft technology and develop the infrastructure for the ballistic missile program for Ghauri missiles. North Korea shared the hardware components (of Nodong and Taepodong missile systems) and helped to transfer Chinese technology through North Korea to Pakistan."China is believed to have agreed to supply components like the guidance systems, the areas in which North Korea does not have sufficient technological capability."[79] Apart from China and North Korea, some European countries also facilitated Pakistan in the early stages of rocket development. Like "France transferred technology to manufacture sounding rockets and German firms assisted in space research and supplied several tons of ammonium perchlorate, an ingredient of solid rocket fuel. The UK also helped with sounding rocket launches."[80] In 1995, the United States cautioned European countries on supplying missile-production equipment to SUPARCO.

Because of these restrictions, SUPARCO contacted its Asian partners. However, it did not turn out well as Taiwan (March 1996) confiscated shipments of around 15 tons of ammonium perchlorate for SUPARCO, shipped from North Korea.[81] Just one month later, another shipment of ammonium perchlorate in a quantity to fuel nearly 25 missiles was seized by Hong Kong customs .[82] Of course, SUPARCO denied the shipments. In 1998, SUPARCO came under sanctions again for "unspecified involvement" in nuclear and missile technology. Thus, under section 102(b) of the Arms Export Control Act of the United States, the Bureau of Export Administration imposed more sanctions against India and Pakistan for denying their licensing of exports of items restricted under nuclear nonproliferation and missile technology.[83] In 2001, President George W. Bush lifted the 1991 and 1998 sanctions by exercising waiver authority granted by Congress.[84] The new era of China-Pakistan space cooperation further tests the validity of MTCR in present times. According to the South China Morning Post, Pakistan had bought a highly sophisticated, large-scale optical tracking and measurement system that is critical for missile testing from China .[85] Pakistan is the first country with whom China shared the application of BeiDou navigation - a parallel system against the US GPS for commercial and military use.[86] As"BeiDou boosts the capabilities of the People's Liberation Army in areas including weapons targeting, guidance, and other services,"[87] it reduces China and Pakistan's reliance and vulnerability to future sanctions from the West.

What Can be Done?

Now when Pakistan's government is prioritizing the country's space program, some measures need immediate attention for wider implications. First, Pakistan requires a strong scientific education base particularly in STEM (Science, Technology, Engineering, and Mathematics) discipline. Pakistan's education system is already in a crippling phase. The ad hoc policy of scholarships for training scientists and engineers is not a solution for developing a firm base for the space program. The current human resource comes from limited programs offering space studies/diplomas that lead to SUPARCO's institutional inbreeding. The government of Pakistan must reform education policies with greater emphasis on applied sciences. Because Pakistan's need for commercial satellites is rising every year, public demand for internet users is increasing. As of 2020, there are 76.38 million internet users in Pakistan, of which around 37 million use social media. For increasing greater awareness and interest in the national space agency, the rural population needs access to education and the internet.

Second, SUPARCO, like several other space agencies of the world, needs civilian oversight to yield research and development and create a better work environment. Like other countries, SUPARCO needs to give contracts to government-owned, but not government-managed, companies. It needs to promote merit over seniority and reward young scientists/engineers to work and compete for their research projects to enhance innovation and promote ideas. The agency operating under military leadership is a less attractive workplace for young graduates. From independent reviews of the SUPARCO employees (former and current), only 53% recommend the organization for the job to newcomers and not one reviewer approves of the CEO of the organization, the chairman.[88] Out of 22 reviews, 31% of reviews do not recommend the organization for the job. Employees' reviews also suggested that the"chairman should be within the organization and have at least relevant background to run the National Space Agency."[89] The usual complaints are "no career progress…, no respect for staff officials…office etiquette is more important than productivity and timeliness."[90] Some mentioned that "the talent gets rusted here, no appreciation for hard work"[91] while others complained about the behavior of senior management saying that "the immediate superior always suppress your complaint/request/application."[92] One reviewer said,"qualification and performance are not given very healthy weight. Rather, the seniority matters the most."[93] "Remove the element of fear from within your employees. This will enhance their output," "Reduce procedures and encourage research work more."[94] These comments show dissatisfaction among employees who currently work or already left. Former chairperson SUPARCO also confirmed that "The National Command Authority just has a different work ethic. There are stringent requirements for both recruitment and performance."[95]

Third, SUPARCO's institutional identity seems compromised and the institution's new role is unclear? The limited scope of focusing entirely on space satellites is not enough. SUPARCO's 2040 space vision allocated $22 million for the multi-mission program for launching five GEO and six LEO (low Earth orbit) satellites into space in cooperation with China. Apart from satellites, the missile production-related work is already given to other strategic organizations such as National Defense Complex (NDC), Air Weapons Complex (AWC), Defense Science and Technology Organization (DESTO), Pakistan Atomic Energy Commission (PAEC), and Pakistan Ordnance Factories (POF). It seems that SUPARCO provides the auxiliary support to buttress the nuclear program of the country instead of having an independent mission. One of the former chairmen said, "We do a lot of gratis work for the government…By Sept 1, 2010, we had done about $4 million worth of gratis work."[96] To keep its identity, SUPARCO needs to widen its expertise through a public-private partnership, create awareness of science and development at universities/schools to create human resource pool, and develop a competitive market for research and development in space exploration to reward youngsters to join the commission.

Conclusion

Pakistan's space program lags behind other Asian powers due to a lack of professional expertise in space sciences and applied studies. The commission never had the expertise for developing 'indigenous' missiles or satellites. The sounding rockets (Rahber-1 and 2) were Nike-Cajun rockets from NASA. From Ghauri systems to Shaheens, Pakistan has been taking assistance from Asian partners, particularly China, to develop its missile program. Instead of harnessing a strong education base for Science and Technology in the country, successive governments relied on makeshift arrangements of foreign training and technology assistance to complete projects. The research also concludes that Pakistan's Ababeel missile is a design for a satellite launch vehicle that the military tested in the missile role to deter India's ballistic missile program. The MIRVs test does not show the independent targeting capability of each warhead. The study also concludes that despite the government's ill-conceived space vision, SUPARCO as an organization faces serious challenges, particularly under military leadership. The slow pace of research and development, dissatisfaction among employees, and lack of incentive for young graduates to seek employment in the commission enunciate that the space agency needs dedicated mission and civilian oversight, as India has with ISRO. Pakistan-China space cooperation cannot give Pakistan a breakthrough against its regional competitor, India. The space expedition is costly. SUPARCO should benefit from the public-private partnership and invite private companies to invest in space exploration, taking inspiration from Elon Musk's SpaceX.

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Notes

1. Among 104, three satellites were from India and other Nano-satellites were from five other countries including U.S., the Netherlands, Kazakhstan, Israel and Switzerland. For details see Samantha Mathewson,"India Launches Record-Breaking 104 Satellites on Single Rocket," February 15, 2017,https://www.space.com/35709-india-rocket-launches-record-104-satellites.html

2. Salman Siddiqui,"LaggingBehind: 2040 - Pakistan's Space Od[d]yssey,"*The Express Tribune*, August 01, 2012, https://tribune.com.pk/story/415738/lagging-behind-2040-pakistans-space-oddyssey/

3. Pakistan's incumbent Minister for Science and Technology tweeted @fawadchaudhary, July 25, 2019 at https://twitter.com/fawadchaudhry/status/1154293483504619520?lang=en

4. "Pakistan Aims to Send First Astronaut into Space by 2022,"*Reuters*, July 25, 2019 athttps://www.reuters.com/article/us-space-pakistan/pakistan-aims-to-send-first-astronaut-into-space-by-2022-idUSKCN1UK1PI

5. Humza Irfan, "Pakistan's Space Programme: Achievable Goal or Impossible Dream?,"*The Express Tribune*, April 23, 2019, https://blogs.tribune.com.pk/story/79106/pakistans-space-programme-achievable-goal-or-impossible-dream/

6. Raja Mansoor, "Pakistan Is Losing the Space Race,"*The Diplomat*, February 01, 2018, https://thediplomat.com/2018/02/pakistan-is-losing-the-space-race/

7. Bilal Karim Mughal, "Metro Bus or Mars: The Problem with OurPriorities,"*Dawn*, September 27, 2018 at https://www.dawn.com/news/1134488/metro-bus-or-mars-the-problem-with-our-priorities

8. Ali Ahsan and Ahmed Khan, "Pakistan's Journey into Space,"*Astropolitics*vol. 17, no. 1 (2019) at https://doi.org/10.1080/14777622.2019.1578933

9. Abdus Salam's expertise was in theoretical and particle physics. His higher education and training was from the United Kingdom and U.S. After completing graduation, Salam went to Cavendish Laboratory (UK) to secure his doctorate on "Developments in Quantum Theory of Fields." In 1959, he was selected as a fellow at the Royal Society and at the Princeton University. Salam returned to Pakistan in 1960. After his return, he was appointed Member Technical in the PAEC. For details see, A.M. Hamende, "Tribute to Abdus Salam: Commemoration Day," 21 November 1997, pp. 101-108,https://unesdoc.unesco.org/ark:/48223/pf0000119078

10. Included Salim Mahmud, Sikander Zaman, and Tariq Mustafa.

11. "Pakistan Derives its First 'Hatf' Missiles from Foreign Space Rockets,"*The Risk Report*, vol. 1, no. 8 (October 1995), p. 4.

12. See SUPARCO's official website athttp://www.suparco.gov.pk/pages/history.asp

13. "Beginner's Guide to Space," at http://www.suparco.gov.pk/downloadables/space-booklet-english-2015.pdf

14. See SUPARCO's official website at http://www.suparco.gov.pk/pages/history.asp

15. Ibid.

16. "Pakistan Missile Chronology,"*Nuclear Threat Initiative*, 114, https://media.nti.org/pdfs/pakistan_missile_1.pdf

17. Missile Defense Project, "Hatf 1,"*Missile Threat*, Center for Strategic and International Studies, September 16, 2016, last modified June 15, 2018, https://missilethreat.csis.org/missile/hatf-1/

18. Ibid. For details also see Arvind Kumar and Michael Vannoni,"Ballistic Missile Proliferation in Southern Asia: Options for Stabilization, (Sandia National Laboratories,"Cooperative Monitoring Center Occasional, Paper 3/4 at http://www.sandia.gov/cooperative-monitoring-center/_assets/documents/sand2004-0317.pdf.

19. R. Ramachandran, "Pakistan's Ballistic Response,"*Frontline*,vol. 16, no. 9, (April-May 1999),https://frontline.thehindu.com/static/html/fl1609/16090290.htm

20. Quoted in Ajey Lele,*Asian Space Race: Rhetoric or Reality?*(New Delhi: Springer, 2013), p. 45.

21. "Pakistan Derives its First "Hatf" Missiles from Foreign Space Rockets," Wisconsin Project, October 01, 1995, https://www.wisconsinproject.org/pakistan-derives-its-first-hatf-missiles-from-foreign-space- rockets/

22. Ibid.

23. ISPR, Press Release No PR-94/2011-ISPR, April 19, 2011, https://www.ispr.gov.pk/press-release-detail.php?id=1721

24. Michael Laufer, "A. Q. Khan Nuclear Chronology," September 07, 2005 at https://carnegieendowment.org/2005/09/07/a.-q.-khan-nuclear-chronology-pub-17420

25. Badr-1 was Pakistan's first experimental satellite Badr-1 jointly built by SUPARCO and CNSA, launched by China's Long March 2E rocket on July 16, 1990.

26. Badr-B at https://directory.eoportal.org/web/eoportal/satellite-missions/b/badr-b

27. Ibid.

28. Badr-B, RAL Space at https://www.ralspace.stfc.ac.uk/Pages/BADR-B.aspx

29. Ibid.

30. Sa'adia Reza, "Pakistan Risks Losing Orbital Slot if Satellite Not Launched," Dawn, October 20, 2008 at https://www.dawn.com/news/971457

31. Ibid.

32. Ibid.

33. The satellite suffered battery-charge controller failure losing its ability to recharge the battery thus, making it unfit for the mission. Indonesia then considered the satellite as'unusable', gave it back to Hughes after the insurance of $31 million.

34. Sehrish Wasif, "Pakistan Launches Two Satellites Using Chinese Rocket,"*The Express Tribune*, July 09, 2018, https://tribune.com.pk/story/1753260/1-pakistan-launches-two-satellites-using-chinese-rocket/

35. Andrew Jones, "Two Chinese Launches in 24 Hours Deliver Pakistan Satellites, Beidou Backup to Orbit,"*Space News*, July 10, 2018, https://spacenews.com/two-chinese-launches-in-24-hours-deliver-pakistan-satellites-beidou- backup-to-orbit/

36. Space Silk Road: Pakistan and China Enhance Space, Science and Technology Cooperation," at https://spacewatch.global/2018/11/pakistan-and-china-enhance-space-science-and-technology- cooperation/

37. E.F. Lambin, "Remote Sensing and Geographic Information Systems Analysis," International Encyclopedia of the Social & Behavioral Sciences(2001) at https://www.sciencedirect.com/topics/computer-science/multispectral-data

38. Pallava Bagla, "To Keep An Eye On India, 2 Pak Spy Satellites Launched By China,"*NDTV,* July 09, 2018 at https://www.ndtv.com/world-news/china-launches-2-satellites-for-pakistan-strengthens-space-cooperation-1880458

39. Ibid; Also see Sehrish Wasif, "Pakistan Launches Two Satellites Using Chinese Rocket,"*The Express Tribune*, July 09, 2018, https://tribune.com.pk/story/1753260/1-pakistan-launches-two-satellites-using-chinese-rocket/

40. Sehrish Wasif, "Pakistan Launches Two Satellites Using Chinese Rocket," op cit.

41. ELV consists of several rocket stages that sequentially fall off as the fuel exhausts by gaining speed and reaching a higher altitude.

42. "Paknet Launches New Internet Service,"*The News*, November 02, 1999, https://www.pakistanpressfoundation.org/paknet-launches-new-internet-service/

43. Sa'adia Reza, "Pakistan Risks Losing Orbital Slot if Satellite is Not Launched, op cit.

44. bid.

45. Adnan Rahmet, "Pakistan Wants to Send Space Program into Global BigLeague,"*Arab News*, June 25, 2018 at https://www.arabnews.pk/node/1327751

46. Rocket or space booster is the first stage of the space launch vehicle that augments the takeoff thrust and payload capability. It falls off to earth once the fuel is used.

47. "Pakistan's 'Shaheen III?' Space Booster Development," Launch Vehicles, August 20, 2009 athttps://www.globalsecurity.org/space/world/pakistan/pakistan-shaheen-iii-space-booster.htm

48. Ibid.

49. Mateen Haider, "Test Launch of Shaheen-III Ballistic Missile Successful: ISPR,"*Dawn*, March 09, 2015, https://www.dawn.com/news/1168421/shaheen-iii-ballistic-missile-test-launch-successful-ispr

50. Farva Kaukab, "SUPARCO Finds it Hard to Deal with Local Govt,"*Dawn*, February 20, 2012, https://www.dawn.com/news/696932/suparco-finds-it-hard-to-deal-with-local-govt

51. Zachary Keck, "Pakistan Has Just Tested the Ultimate Nuclear Missile,"*The National Interest*, March 09, 2018, https://nationalinterest.org/blog/the-buzz/pakistan-has-just-tested-the-ultimate-nuclear-missile -24834

52. "Kuai Zhou (Fast Vessel),"*China Space Report*, https://chinaspacereport.wordpress.com/launch-vehicles/kuaizhou/

53. Humza Irfan, "Pakistan's Space Programme: Achievable Goal or Impossible Dream?,"*The Express Tribune*, April 23, 2019, https://blogs.tribune.com.pk/story/79106/pakistans-space-programme-achievable-goal-or-impossible-dream/

54. at https://www.ist.edu.pk/academics/degrees-programs/graduate-ms

55. See the official website of NUST at http://www.nust.edu.pk/Pages/Default.aspx

56. See the official website of University of the Punjab at http://pu.edu.pk/home/research/62/0/Department-of-Space-Science

57. "Re-Visiting Pakistan's Space Program with Major General Ahmed Bilal," [Interview] YouTube, April 11, 2019 at https://www.youtube.com/watch?v=0W5EdMZgPKI&t=15s

58. Zakaria Virk, "Dr. Abdus Salam: the Guiding Force for Modern Age,"*Technology Times* [Weekly] II, https://technologytimes.pk/documents/mag/2013/Supplement-Abdus-Salam-2013/Dr%20Salam%20Supplement.pdf

59. Author interview with Secretary SUPARCO Air Cmdr. ® Arshad Siraj through email correspondence on May 19, 2019.

60. Ibid.

61. The center is part of a three-year national AI program.

62. It is a consortium of 12 technology universities and 45 advanced learning labs, having more than 200 Ph.D. scientists and technologists.

64. "Pakistan GDP Growth Rate," https://tradingeconomics.com/pakistan/gdp-growth

65. "Pakistan-Overview,"*The World Bank*, April 05, 2019, https://www.worldbank.org/en/country/pakistan/overview

66. Taha Siddiqui,"Why Pakistan's economy is sinking,"*Al-Jazeera*, June 28, 2019 at https://www.aljazeera.com/indepth/opinion/pakistan-economy-sinking-190628174320798.html

67. arhan Bukhari, "Pakistan to Freeze Military Budget as Tensions with India Linger,"*Asian Review*, June 10, 2019 at https://asia.nikkei.com/Politics/Pakistan-to-freeze-military-budget-as-tensions-with-India-linger

68. Ibid.

69. Drazen Jorgic, "In Rare Move, Pakistan Military Agrees to Budget Cut Amid Economic Woes, PM Says,"*Reuters*, June 05, 2019 at https://www.reuters.com/article/us-pakistan-military/in-rare-move-pakistan-military-agrees-to-budget-cut-amid-economic-woes-pm-says-idUSKCN1T60PY

70. Usman Ansari, "Pakistan pushes for homegrown satellite development,"*Defense News*, May 03, 2018, https://www.defensenews.com/space/2018/05/03/pakistan-pushes-for-homegrown-satellite- development/

71. Humza Irfan, "Pakistan's Space Programme: Achievable Goal or Impossible Dream?," op cit.

72. "China, Pakistan Sign Agreement on Space Exploration,"*The Economic Times,*April 29, 2019, https://economictimes.indiatimes.com/news/international/world-news/china-pakistan-sign-agreement-on-space-exploration/articleshow/69101917.cms?from=mdr

73. Adnan Rehmat, "Above the BlueSky, Into the Blackness of Space,"*The News on Sunday*, August 04, 2019 at https://www.thenews.com.pk/tns/detail/568220-blue-sky-blackness-space

74. "China's 'Belt and Road' Plan in Pakistan Takes a Military Turn,"*The New York Times*, December 19, 2018, https://www.nytimes.com/2018/12/19/world/asia/pakistan-china-belt-road-military.html

75. Report to Congress, May 16, 2018, https://media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER- REPORT.PDF

76. See SUPARCO's website at http://www.suparco.gov.pk/downloadables/PAKSAT%201R%20Press%20Release.pdf

77. Henry Sokolski's testimony "Space Technology Transfers & Missile Proliferation," presented before*The Commission on the Ballistic Missile Threat Barriers and Pathways to Proliferation*on April 10, 1998 Arlington, Virginia available athttp://npolicy.org/article.php?aid=452&tid=2

78. "Imposition of Missile Proliferation Sanctions Against Chinese and Pakistani Entities," 56 Federal Register 137 (25 June 1991), p. 32601.

79. Joseph Bermudez, "A silent partner,"*Jane's Defense Weekly*(Coulsdon, Surrey), 20 May 1998.

80. "Pakistan Derives its First "Hatf" Missiles from Foreign Space Rockets," op cit.

81. See*Pakistan: Energy Policy, Laws, and Regulations Handbook,*Volume 1 (Washington D.C.: International Business Publications, 2015), 260; Space and Upper Atmosphere Research Commission (SUPARCO),*Nuclear Threat Initiative*, https://www.nti.org/learn/facilities/637/

82. Vehicles," https://www.globalsecurity.org/space/world/pakistan/launch.htm

83. India and Pakistan Sanctions and Other Measures," 63 Federal Register 223 (19 November 1998): 64322-64342, https://www.govinfo.gov/app/details/FR-1998-11-19/98-30877

84. "India and Pakistan: Lifting of Sanctions, Removal of Indian and Pakistani Entities, and Revision in License Review Policy," 66 Federal Register 190 (1 October 2001), p. 50090, https://www.federalregister.gov/documents/2001/10/01/01-24648/india-and-pakistan-lifting-of-sanctions-removal-of-indian-and-pakistani-entities-and-revision-in

85. Stephen Chen, "China Provides Tracking System for Pakistan's Missile Programme,"*The South China Morning Post*, March 22, 2018, https://www.scmp.com/news/china/society/article/2137643/china-provides-tracking-system-pakistans-missile-programme

86. "Suparco Set to Get Global Navigation Satellite System,"*Dawn*, September 26, 2012, https://www.dawn.com/news/752156/suparco-set-to-get-global-navigation-satellite-system-2

87. Andrew Jones, "China Launches Latest Beidou Satellite for Global Navigation System,"*China Space News*, June 24, 2019, https://spacenews.com/china-launches-latest-beidou-satellite-for-global-navigation-system/

88. See SUPARCO Reviews at https://www.glassdoor.com/Reviews/SUPARCO-Reviews-E370340_P3.htm

89. Ibid.

90. Ibid.

91. Ibid.

92. Ibid.

93. Ibid.

94. Ibid.

95. Ibid.

96. Farva Kaukab, "Suparco Finds it Hard to Deal with Local Govt," op cit.

Nuclear Planning in an Uncertain World

Brooke Mitchell*

. . . research is called for on what type of thermonuclear war might eventuate, and on the possible volume of material destruction and loss of human life that might occur in varying hypothetical attack situations.[1]

The 2018 Nuclear Posture Review (NPR) emphasizes a return to great power competition in a world that is no longer preoccupied by violent Islamic fundamentalism in the Middle East and Central Asia.[2] Great power politics are back in style, as the Trump administration made clear. In the post-Cold War era, the United States Department of Defense is focused on modernizing its nuclear enterprise in the face of an adversary that never stopped. Both Russian and Chinese aggression left the United States little option but to refocus its attention on nuclear and conventional operations and modernization designed to counter great power threats.

Written once per administration and published only four times since its inception, the NPR is the Pentagon's primary statement on United States nuclear policy. Highlighting the importance of deterring adversaries and assuring allies, the Trump administration's NPR also emphasizes "the capacity to hedge against an uncertain future."[3]

The United States' nuclear enterprise has yet to experience the long-term impact of a one-term administration's NPR. With transition into a Biden administration defining arms control policy and prioritization, it is uncertain how the semantics of a new NPR will be interpreted by great powers over the course of what is projected to be a second one-term administration.

One thing is clear, nuclear planning always occurs in an uncertain world that is ever-changing and evolving. Strategic foresight, specifically offered by scenario planning, provides nuclear planners tremendous utility in preparing for this uncertain future.

NUCLEAR PLANNING OF THE PAST

Herman Kahn, a leading Cold War nuclear theorists, physicist, and military strategist, saw this future. While working as a young defense analyst at RAND Corporation, Kahn told brief stories to describe the many possible ways nuclear weapons technologies could be used by hostile nations.[4] His storytelling was not a literal picture of predictability but were narratives driven to create an actual sense of plausibility. Credited for first using the term "scenario" to describe an uncertain future, Kahn did not leave planners without methodologies for assessment and analysis.[5] Scenario analysis, also referred to as scenario planning, emerged after

World War II as a forecasting tool. The global impact of thermonuclear warfare was, for Kahn, a topic surrounded by unconventional questions in planning for an uncertain future. Utilizing the Monte Carlo technique, coined by Stanislaw Ulam, who is best known for designing the hydrogen bomb with Edward Teller, scenario planning measured probabilities of plausible futures.[6]

Monte Carlo simulation is a technique used to approximate the probability of an event by running the same simulation multiple times and averaging the results.[7] The Monte Carlo method's primary focus is application of random sampling to problems of applied mathematics.[8] The variables within the sampling provide calculations of averages, or means, across the problem set. Kahn utilized the Monte Carlo Sampling Technique, specific to the design and usage of variance reducing techniques through the analysis of importance sampling, Russian roulette and splitting, use of expected values, correlation and regression, systematic sampling, and stratified sampling.[9]

These models of analysis are best described as forecasting tools within the science of strategic thinking. According to Irene Sanders, "Forecasting is a familiar tool for getting advance information about the future, and is based on analysis of existing conditions and trends. Through analysis and the use of mathematical models, forecasters estimate or calculate a future state."[10]

When forecasting is applied to subject areas such as economics, the reliability of measuring results is more predictable and lends itself to accurate results. In contrast, when forecasting is applied to subject areas such as politics, the reliability significantly diminishes and the complexities significantly increase. For these reasons, forecasting is not as reliable an instrument when measuring uncertainty for scenario planning, which is deeply engrained in social, ideological, and behavioral conditions.

In comparison to forecasting, foresight allows for the examination of plausible futures by measuring uncertainty through qualitative analysis. Sanders notes, "Foresight is the ability to see what is emerging—to understand the dynamics of the larger context and to recognize new initial conditions as they are forming. With foresight, we see the future as it is taking shape."[11] Foresight both illuminates key threats and opportunities and can also deliver fully specified decision analysis.[12] Analytical rigor is central to effective foresight, "uncertain times require more rigor, not less."[13]

Due to complexities in the analysis and computing of scenarios, Kahn's measurement of uncertainty faced near-extinction if not for his comrades in the film industry. The inspiration behind the character Dr. Strangelove, from the Dr. Strangelove film, is a result of Kahn's influence among his Hollywood producer-friends set. Foreshadowing the "what if" of a nuclear brinksmanship greatly influenced science fiction, the imagery of future worlds, and the plausibility

of "something going wrong with the hydrogen bomb."

During the 1970s, Royal Dutch-Shell and researcher Pierre Wack picked up the process and utilized scenario planning within the petroleum industry.[14] While the process of scenario planning was spared, the methodology became overly reliant on qualitative analysis and less effective in its ability to provide quantitative results. Scenario planning, for the first time, was able to successfully utilize foresight in providing strategic insights into problems in which forecasting had failed previously. Current widespread adaptations and best practices used in scenario planning are central to the work of futurists, academics, and organizational leaders. What was created for a military training tool, specific to nuclear proliferation, has found its mainstay in the mainstream private sector.

Scenario planning by its original design and implications is a nuclear and military strategist's process. In an era of great-power competition, it is time to return scenario planning not only to its roots but also to a methodology conducive for analyzing 21st century United States national security which begs the question: what might Kahn say?

Kahn recognized how quantitative analysis alone may demonstrate certainty while also limiting interpretations. This in turn results in causing massive failure to respond and prepare outside the scope of that data.[15] He understood that Western problems would not be solved with purely military solutions; however, Kahn also recognized that every solution would require participation from a well-designed and employed military. Kahn was a master of perspective. His worldview was further balanced by recognizing the importance of an idealists' influence to a realists' world.[16] Kahn equally acknowledged that danger exists if the realists' contribution is not recognized.

Scenario planning is a methodology that can unify the messaging within the executive and legislative branches for these sobering futures of uncertainty. Kahn saw the importance of the executive office and senior leadership as serving as the primary national security decision maker.[17] At the same time Kahn reasoned that public debate was to be reserved for technical conversations that could be fully explored and researched as opposed to being for purely ad hoc politically convenient uses.

Nuclear-armed states should know the United States and its allies are not only planning for a nuclear response, should tensions mount to such a level, but that American decision makers are actively planning for myriad plausible futures. At the height of the Cold War, Kahn's lectures were available to everyone. He wanted Russia to know and hear American debate on the subject. The same objections Kahn faced when positing his position to sensitive (unclassified) topics still remains:

No one should attempt to think about these problems in a detailed and rational way; what thinking there is on these problems should be done in secret, by the military exclusively or at least by the government; and even if some of this thinking must be done outside the government the results of any such thought should not be made available to the public.[18]

In 1960, Kahn feared that the world might not make it to 1965; yet, over 55 years later we have found our way back to not only a similar but increasingly dangerous nuclear proliferation environment.[19] Kahn focused on avoiding disaster, and buying time, without specifying the amount of time that could be bought. This, of course, assumes time was for sale and there were interested buyers; the same clock is still ticking. The questions Kahn posited remain in current circulation within the professional military education system:

·How likely is accidental war? How can one make it less likely?

·How dangerous is the arms race today? What will it be like in the future?

·What would conditions be like if a nuclear attack leveled 50 of America's largest cities? Would the survivors envy the dead?

·How many million American lives would an American president risk by standing firm in differing types of crises? By starting a nuclear war? By continuing a nuclear war with the hope of avoiding surrender?

·How many European, Soviet, and other lives would he risk?[20]

In the face of modernizing the nuclear arsenal, it is time to modernize the questions and processes used for assessing these uncertainties. This is where scenario planning is of particular value.

If Kahn were alive today, how would he approach planning for hedging nuclear war and responding to a nuclear holocaust? While current adaptations of scenario planning hold value for strategically thinking about nuclear modernization and required capabilities, they fall short in the ability to project recommendations for implementation and possible courses of action for military strategists. Forecasting, or quantitative analysis, is helpful and supports force development and structure. Foresight, or qualitative analysis, expands the opportunity as a useful tool in thinking about warfighting.

This is where the nuclear enterprise holds a stake in taking back a process that was created specifically for this community and its specific challenges. Through globalization and multiculturalism, the competing values and norms domestically and internationally are very different from Kahn's time. However, the sophistication and advancement of technology through machine learning, artificial intelligence, and

autonomous robotics opens the portal to not only a whole new world but also a new way to view the world.

NUCLEAR PLANNING FOR THE FUTURE

Shortfalls that Kahn experienced with forecasting complex scenarios are overcome today by a number of tools that were not available 50 years ago. The benefits found in qualitative exploration of alternative futures can be synced with existing learning platforms, such as but not limited to augmented reality and virtual reality, to channel these scenarios in real-time engagement to experience the outcomes of idealists' and realists' perspectives. In addition, mixed methods research design incorporates both qualitative and quantitative analysis.[21] These knowledge claims allow for examination of pragmatic assumptions that test closed-ended measures with open-ended observations.

In its own way, Monte Carlo simulations were a precursor to artificial intelligence (AI). AI provides answers measured as probabilities. Monte Carlo simulations did the same thing, at a much longer rate, often running answers overnight.

A problem does not have to be very complicated before it gets too difficult for even a modern high-speed computer to do in a straightforward fashion. One of the most powerful techniques available that will often make a seemingly intractable problem tractable, if not easy, and one that is particularly well suited to the electronic computer, is the so-called Monte Carlo method.[22]

This is where context matters. Kahn made this statement in July 1957. In January that year, John E. Kilpatrick of the Rice Institute received a $150,000 contract from the Atomic Energy Commission, Division of Research, in Washington, D.C.; Kahn was attempting to explain Kilpatrick's approach. Kilpatrick's commission was the construction of a high-speed digital computer to aid in analysis.[23] This computer was the size of a room. Today's cell phone technology has more computing capability. Technology has advanced greatly. Scenario planning used to analyze uncertainties around the nuclear enterprise has not advanced at the same rate.

Utilizing and capitalizing on technology advances propels the future of scenario planning for nuclear planning beyond wargaming. "Game theory is not only the study of games, per se, but is more generally the study of any conflict situation . . . The subject matter of Game Theory is usually a highly idealized abstraction of real life. Therefore, most of the games that have been studied do not have (numerically) important normative or predicative aspects."[24] Gaming scenarios often present desirable choices or versions of realities. Combining foresight with forecasting is more difficult to game; however, the results yield realistic plausible scenarios as opposed to idealized versions of reality.What gaming lacks normatively, 21st century models of scenario planning can contain the ability to be both plausible

and predictable.

The untapped potential of this aspect of nuclear planning is an opportunity for researchers. The impact of Kahn's views of strategic deterrence remain influential within national security policy. This is only half of Kahn's premise. He not only provided ideas but also methodologies in which to educate, explore, and evaluate these uncertain futures. Kahn's technological limitations are not ours.

In today's world, Kahn would undoubtedly have advanced his research in areas where the United States has grown stagnant in measuring in the face of modernization; this is an unfortunate conundrum with limitless opportunity. Scenario planning expands opportunities for unclassified discussions for military leaders and partners from academia, industry, and government to channel questions and debate in a constructive manner. The immersion of conversation into virtual worlds that can be measured, felt, and experienced as part of the debate is a productive solution for modernization of the nuclear enterprise.

It is not only the responsibility but also an obligation to utilize technological advancements for not just the sake of research and development but also for the sake of furthering progress for strategic deterrence and assurance. Technology platforms contain the ability to integrate forecasting and foresight to produce the most advanced forms of insights imaginable. This requires collaboration and contributions from the defense sector, private industry, and academia to carry out the processes that Kahn imagined.

Scenario planning holds value as a strategic messaging instrument that shapes the future narrative of the United States' national interests. By not only asking questions from defensive and offensive postures, scenario planning propels the United States into a future posture. Scenario planning has the power to strategically accelerate our posture militarily and diplomatically. "By developing scenarios that include obvious as well as less obvious futures, this process also enables policymakers to hedge against uncertainty. Indeed, a crucial lesson that emerges from scenario based planning is the need to prepare, or at least hedge, against the prospect that a future that reflects the characteristics of one or several scenarios may emerge."[25]

Michael Fitzsimmons of the United States Army War College's Strategic Studies Institute highlights in his monograph on scenario planning that "the approach has fallen short in shaping strategy and force structure."[26] Fitzsimmons outlines very few disputable points in his argument. He highlights that when bureaucratic operations of the Department of Defense's decision-making processes converge with the uncertainty and complexity of scenario planning, what is intended to be a straightforward imperative becomes increasingly complex. There is a limitation to the analysis.

Variations of scenario planning are beneficial when used as a strategic thinking exercise. Fundamentally, scenario planning's history is rooted in measuring the uncertainty of nuclear proliferation. While scenario planning definitely holds value beyond this area, the present-day processes and application are challenging in transferring the practice from private industry back to the military. Stakeholders, players, risks, gains, and losses mean two very different things to CEOs and uniformed leaders. Beyond strategic thinking, the processes fall short in their ability to implement decisions. Commanders make decisions. Devoid of data and facts, it is very limiting to make informed decisions surrounding the United States' most sensitive topics.

By bringing together advocates of scenario planning to create mixed method processes for analysis in both exploring and proactively (both offensively and defensively) preparing for uncertain futures, the call from the NPR is answered. In taking scenario planning back to its original design, it is the marrying of qualitative with quantitative analysis that will garner the attention of decision-makers. Ideas about the future are not the same as indicators about the future. In measuring nuclear uncertainty, indicators are currently missing.

Arguments around the nuclear enterprise are cyclical in a generation that is vastly different from the Cold War. Faced with modernizing an aging arsenal, at a price tag of $1 trillion over two decades, the United States faces an uncertain future against great powers that are certain to remain adversaries. Kahn laid the framework for scenario building, and there is great opportunity to build on his vision for not only assessing but seeing the future. Tapping into augmented and virtual realities through artificial intelligence are methods in which to experience the realities of our decisions; whatever they may be.

"When our reluctance to consider danger brings danger nearer, repression has gone too far."[27] Part of the return to great power competition in modernizing the nuclear arsenal is not only acknowledging an uncertain future but exists in modernizing scenario planning in direct correlation to describe and prepare for the future. It is forever unknown how Kahn would view today's nuclear debate, but it stands to reason in thinking about the future, he would not be asking yesterday's questions.

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Notes

1. Kahn, Herman. *Thinking About the Unthinkable.*New York, NY: Avon Books, 1962.

2. White House, Nuclear Posture Review, February 2018, available at https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF

3.Ibid., 3

4. Kleiner, Art. "The Man Who Saw the Future." Strategy and Business, available from www.strategy-business.com/article/8220

5. Ibid.

6. Guttag, John V. *Introduction to Computation and Programming Using Python with Application to Understanding.*Cambridge, MA: The MIT Press, 2016, 275.

7. Guttag, 2016.

8. Kahn, Herman. "Application of Monte Carlo," Santa Monica, CA: RAND Corporation, 7, 27 April 1956.

9. Kahn, Herman. "Use of Different Monte Carlo Sampling Techniques." Santa Monica, CA: RAND Corporation, 30 November 1955.

10. Sanders, T. Irene.*Strategic Thinking and the New Science: Planning in the Midst of Chaos, Complexity, and Change.*New York, NY: The Free Press, 1998, 109.

11. Ibid., 110.

12. Courtney, Hugh. *20/20 Foresight: Crafting strategy in an uncertain world.*Boston, MA: Harvard Business School Press, 2001, 131-133.

13. Ibid.

14. Ralston, Bill and Wilson, Ian. *The Scenario Planning Handbook: Developing Strategies in Uncertain Times.*Mason, OH: Thomson Higher Education, 2006.

16. Ibid.

17. Ibid.

18. Kahn, H. (1962,20).

19. Ibid.

20. Ibid., 21 – 22.

21. Creswell, John W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.*Thousand Oaks, CA: Sage Publications, 2003, 20.

22. Kahn, Herman and Mann, Irwin. "Monte Carlo." Santa Monica, CA: RAND Corporation, 30 July 1957.

23. United States Atomic Energy Commission. Research and Development Division. Available, https://ricehistorycorner.com/2017/07/31/the-construction-of-a-high-speed-digital-computer-january-1957/.

24. Kahn, Herman and Mann, Irwin. "Game Theory." Santa Monica, CA: RAND Corporation, 30 July 1957.

25. Krepinevch, Andrew F. and Cohn, Jacob "Rethinking Armageddon: Scenario Planning in the Second Nuclear Age."*Center for Strategic and Budgetary Assessments,* 2016.
https://www.files.ethz.ch/isn/196231/CSBA6158-NuclearScenarios-PRINT_Final.pdf.

26. Fitzsimmons, Michael. "Scenario Planning and Strategy in the Pentagon."*United States Army War College Press,* January 2019. https://www.jstor.org/stable/resrep20079?seq=1#metadata_info_tab_contents

27. Kahn, H. (1962,20).

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USAFA Academy Assembly Keynote Address

National Security and American Polarization: The Competition for Truth

October 13, 2020

Thank you for the great privilege of joining you for the Academy Assembly and thanks, especially, for your decision to serve your country and your fellow servicemen and women during what, I believe, is a time of growing danger to American security, prosperity, and influence in the world. But I am confident that you will make significant and lasting contributions across a career of service and help build a better future for generations of Americans to come.

The crucial challenges we face today include those that revisionist powers China and Russia propose; growing transnational threats from pandemics to jihadist terrorists; hostile states such as Iran and North Korea; and the potential for proliferation of the most destructive weapons on Earth and destructive technologies that have made space and cyberspace competitive domains with implications for security across our planet and in the physical world. But the most pernicious danger to our future may lie closer to home, and that is why our society is in danger.

It is in danger because it is diminishing our confidence and I was very glad to see the topic you chose for this year's Academy Assembly. Political polarization affects not only our ability to overcome crucial challenges to our security, prosperity, and influence in the world, but also our confidence in who we are as a people and in our democratic principles, institutions, and processes. We all have a role in overcoming it. As a historian, I try to understand how the recent past produced the present as the first, and essential, step toward making projections into the future. So I thought I'd begin with a description of how we lost confidence in our ability to conduct a sustained and effective foreign policy before recommending how we might improve our confidence, in part, through rebuilding our strategic competence. And we could all work to understand divisions in our society and suggest what we might do as military professionals and citizens to overcome those divisions and restore the pride and confidence necessary to come together as Americans and strengthen our nation from within as we cope with challenges that originate abroad.

Our strategic competence has diminished since the end of the Cold War. I witnessed that loss. In 1989, I was a captain in the 2nd Armored Cavalry Regiment, headquartered in Nuremberg, Germany. Our regiment patrolled a stretch of the Iron Curtain, along 375 kilometers of the West-German/East-German border and 365 kilometers of the German-Czech border, and Eagle Troop portrayed a portion of

that border around Kohlberg. This is the town where Martin Luther translated the Bible into German; the town that is also home to what I believe are some of the best beers in the world. That November, the Iron Curtain parted and the Berlin Wall fell. The throngs of East Germans who flooded across the border presented our scouts with bouquets of flowers and bottles of wine. There were hugs and tears of joy. The East German government withered away. The Soviet Union collapsed. America won the Cold War. But then came a hot war, far away from the Iron Curtain.

In 1989, Saddam's first decade as dictator was coming to a close. He should have been fatigued. In 1980, he had started a disastrous eight-year war with Iran that killed over 600,000 people. Since seizing power in 1979, he had murdered over one million more people, in a population of 22 million, including an estimated 180,000 Kurds and a genocidal campaign in which he used poison gas to massacre entire villages. But in 1990, Saddam felt more underappreciated than fatigued. Had he not defended the Sunni Muslim and Arab world against the scourge of Iran's Shia Islamist revolution, [and did] not Kuwait, Saudi Arabia, and other states owe him a debt of gratitude and cash to pay off his war debts?

On 2 August, the first of over 300,000 Iraqi troops poured into Kuwait to make that small, but wealthy, nation Saddam's 19th province. President George W. Bush and his team got a coalition of 35 nations to agree that the annexation would not stand. Those same troopers who were patrolling the West German/East German border in November 1989 arrived in Saudi Arabia just after German reunification day, almost exactly one year after they watched the Iron Curtain part. Three months later, Eagle Troop was leading the so-called "left hook" to crush Saddam's Republican Guard and kick open the door to Kuwait with a blow from the western desert. By 26 February, 1991, the 2nd Armored Cavalry Regiment had been in Iraq for three days. We had initiated our attack after an extensive air campaign that degraded Saddam's army significantly. Eagle Troop had nine 70-ton Abrams tanks and 12 Bradley fighting vehicles. We also had three of these new devices called GPS. They worked sporadically so scouts navigated mainly by dead reckoning in a flat, featureless desert. Most importantly, though, Eagle Troop had 132 soldiers who were well-trained and confident: confident in their equipment and confident in each other. We were soldiers bound together by mutual trust, respect, and affection.

At 4:07 p.m. on the 26th, we encountered a much larger defending enemy force of Iraq's Republican Guard. We achieved an early advantage in that fight and followed our initial blows with an assault that destroyed that force in approximately 23 minutes. Our fight was a lopsided victory in a larger battle at a war that were lopsided victories. In retrospect, though, those successes that I had the opportunity to bear witness to in Bavaria and at the Battle of 73 Easting marked the end of an era. American leaders across both political parties had reason to be confident. But overconfidence led to complacency. Many forgot that the United States had to

compete in foreign affairs and embraced three flawed assumptions about the emerging post-Cold War era.

First, some believed that an arc of history had guaranteed the primacy of free and open societies over authoritarian and closed systems. The expansion of liberal democracy was inevitable. Second, some assumed that the old rules of international relations were now irrelevant. Global governance in a great power condominium would displace rivalry. Third, some asserted that America's unmatched military prowess would guarantee full-spectrum dominance over any potential enemy. What some called the revolution in military affairs had ended military competition. All three assumptions were false. From Vladimir Putin in Russia to the Kim family regime in North Korea, autocracy is alive and well.

Jihadist groups from Al Qaeda to the Islamic State have bypassed the United States' superiority in conventional warfare and engaged in asymmetric warfare, and a new great power competition emerged as the Chinese Communist Party leadership spoke the language of cooperation while conducting one of the greatest peacetime military buildups in history, suppressing freedom at home, exporting its authoritarian model, and undermining international organizations and the rules-based international order.

Hubris is an ancient Greek term defined as extreme pride that leads to overconfidence and often results in misfortune. In Greek tragedies, the hero vainly attempts to transcend human limits and does not listen to warnings that portend disaster. Consider this from the preface of President Bill Clinton's December 2000 National Security Strategy: "As we enter the new millennium, we are blessed to be citizens of a country enjoying record prosperity with no deep divisions at home, no overriding external threats abroad, and history's most powerful military. Americans of earlier eras may have hoped to one day live in a nation that could claim just one of these blessings. Probably few expected to experience them all. Fewer still, all at once."

At the turn of the century, we were set up for a Greek tragedy. U.S. leaders failed to appreciate that the Gulf War seemed easy, mainly because of Saddam's ineptitude, and a very narrowly circumscribed political objective: just return Kuwait to the status quo ante. Give Kuwait back to the Kuwaitis. Meanwhile, as my friend and fellow historian Colonel Conrad Crane observed, our enemies and adversaries learned that there are two ways to fight the United States military: asymmetrically or stupidly. Al Qaeda chose the former and on September 11th, 2001, 19 terrorists used box cutters and airplanes to commit mass murder attacks that took the lives of nearly 3,000 innocents and inflicted trillions of dollars of losses on the American economy.

Those flawed assumptions of the 1990s stemmed from what we might call strategic

narcissism, the tendency to define problems as we would like them to be. Strategic narcissism encourages the conceit that others have no aspirations or agency, except in reaction to U.S. policies enacted. It generates policies and strategies that are based on what the purveyor prefers rather than what the situation demands. Today, strategic narcissism fosters a sentiment among many in both political parties that after long and costly wars, U.S. disengagement from overseas challenges would be an unmitigated good.

The excessive optimism of the 1990s shifted to extreme pessimism due to the financial crisis of 2008 and the unanticipated length and difficulty and cost of the wars in Afghanistan and the wars in the Middle East. Pessimism generated a bias toward resignation and an associated tendency to view retrenchment or withdrawal as the best way to reduce costs and advance American interests.

For example, the Trump administration has recently portrayed the decision to withdraw small contingents of U.S. forces that are enabling Afghan and Iraqi forces to bear the brunt of the fight against Jihadist terrorists as protecting rather than jeopardizing hard-won military gains.

Those decisions overlooked the lesson of the Obama administration's complete withdrawal from Iraq in December 2001. U.S. disengagement at that time created ideal conditions for the massive Islamic State offensive in 2014, which eventually allowed the most destructive terrorist organization in history to control territory the size of Britain. The most adamant advocates of disengagement are archetypes of strategic narcissism. They believe that the United States is the principal cause of the world's problems. Our presence abroad, they argue, creates enemies. Our absence would restore harmony. The United States, therefore, is to blame for antagonizing Russia and China. America, they believe, causes jihadist terrorism because U.S. presence in predominantly Muslim countries generates a natural backlash. The United States drives nuclear proliferation, they argue, because states like Iran and North Korea need those weapons to defend against an aggressive United States. But the historical record makes clear that American behavior did not cause Russian and Chinese aggression, jihadist terrorism, or the hostility of Iran and North Korea. Disengagement would not solve any of those challenges, despite the ahistorical nature of their argument. Calls for American withdrawal are bound to gain adherents these days as the nation emerges from our triple crises associated with the pandemic, economic recession, and social unrest sparked by the murder of George Floyd.

The balance of power has been shifting against the United States and other free and open societies. Much of that shift has been self-inflicted. Strategic narcissism has impelled overoptimistic policies that underappreciated the risks and cost of action, as well as pessimistic policies that underestimated the risks and costs of inaction.

There is an alternative: sensible and sustained engagement. The COVID-19 experience reinforces a fundamental lesson of September 11, 2001: threats that originate abroad, if not checked, can move rapidly across our world. Once they penetrate our shores, the cost to the American people can prove difficult to bear.

Moreover, it is much cheaper to deter Russia or China with strong alliances and forward-positioned American joint forces than it would be to bear the costs of a catastrophic war triggered by Kremlin or Chinese Communist Party aggression. It is indeed past time to restore America's strategic competence based on a clear understanding of crucial challenges to American security, and, what the historian Zachary short-terms "strategic empathy", the recognition that others exercise influence and authorship over our collective future. Empathy displaces narcissism with an appreciation of the emotions, aspirations, and ideologies that drive and constrain the other, particularly rivals, adversaries, and enemies. All of you have a role in overcoming strategic narcissism and fostering strategic empathy. Your education at the Academy is important, especially, I would argue, in the disciplines of military and diplomatic history.

Your great institution is ideally positioned to develop strategic competence by enriching the history curriculum and connecting the study of history to the interdisciplinary study of strategy. I think the initiative underway now with the Institute for Future Conflict is immensely important and the Academy should be credited for this important initiative that will be critical to restoring our strategic competence. So let's look at this interdisciplinary study of war and warfare and of strategy. What should we aim for? I think the study of history, to think in time and to reason by historical analogy. We often neglect continuity in the nature of war and are captured by change. We believe that really, the next war will be fundamentally different from all that have gone before it. The study of security studies to better understand geopolitical trends and essential elements of effective strategy. Language, geography, and area studies to understand enemies, adversaries, and populations among whom wars are fought. Sociology and political science to understand civil-military relations in our society and to help maintain the connection between our military and those in whose name we fight and serve. Psychology to understand the cognitive pitfalls associated with blunders and strategic failures. Philosophy, theology and ethics and law to develop empathy and solidify a commitment to moral and ethical conduct in war consistent with our values. Leadership to understand how to develop and execute strategies as well as provide the purpose, direction and motivation necessary to lead our military to lead our servicemen and women to maintain morale and also to maintain popular will in war.

So the study of history in the interdisciplinary study of war strategy is essential. It's essential so that the hard-won lessons learned from our recent conflicts do not, in the words of the historian Carl Becker, "lay inert in unread books". But we must go

beyond improving our competence and do our part to generate the confidence necessary to implement a sustained approach to foreign policy and national security.

George Floyd's murder and the deep divisions in our society laid bare in the wake of his murder and during the protests and the violence sparked in the midst of a pandemic have sapped confidence in our common identity as Americans. I believe in part it is a lack of empathy for one another that is catalyzing a destructive combination of identity politics, vitriolic partisan rhetoric, bigotry and racism. Lack of empathy is rooted fundamentally in ignorance. Those who know least about issues and who are strangers to their fellow Americans seek affirmation of their biases rather than knowledge. They judge their neighbors rather than try to understand their perspective.

History, I believe, can play a role here as well. We might reinforce the worn fabric of our society by considering how our past produced our present. Divisions in our society and civil unrest associated with them are not new. A broad historical perspective leads us to the conclusion that we are still coping with the legacy of slavery. As bias and vitriol contaminate the information environment today, the manipulation of history remains an important and important tool for those who want to sow division and conflict rather than foster unity and goodwill. Ignorance of history compounded by the abuse of history undermines our ability to work together and improve our nation and our society, because it saps our national pride. As the late philosopher Richard Rorty observed, National Pride is to countries what self-respect is to individuals, a necessary condition for self-improvement.

Pride in our nation should not derive from a contrived, happy view of history but rather from a recognition that the American experiment in freedom and democracy always was and remains a work in progress. For example, the Emancipation of 4 million people after the most destructive war in our history was only the beginning of a long journey for equal rights. Milestones along that journey included the failure of reconstruction after the Civil War, Jim Crow segregation, and the rise of the Ku Klux Klan and "separate but equal."

In the 1960s, the civil rights movement dismantled the legal basis for Jim Crow segregation. But cultural, economic, educational, and other forms of disenfranchisement continued. The manipulation of history was foundational to the obstruction of equal rights for black Americans, as the myth of the lost cause portrayed slavery as benign instead of cruel and the Civil War as a noble effort to preserve states' rights rather than slavery. But it is also an abuse of history to cast the American Revolution as an effort to preserve slavery rather than a righteous struggle to found a nation on principles that ultimately rendered that horrible institution unsustainable. It is indeed possible to celebrate the principles enshrined in our Declaration of Independence and Bill of Rights, and also recognize that much of

our history has cut against those principles, and that work remains to realize them. We are fortunate. We are fortunate that we can make progress because our Republic was founded on the radical idea that sovereignty lies neither with King nor parliament, but with the people.

With just over, you know, I guess maybe about a month or so a month to go, before the November elections, we might ask candidates for office, or the American people might, not cadets at the Academy, to give us their answers to the following questions while also considering what we might do ourselves because we have agency as citizens in our country. How to rebuild trust in American institutions at the national and local levels, with an emphasis on police reform, police-community relations, and the rule of law? How to rekindle hope among rural and urban communities that have lost sight of the American Dream by improving education, abolishing the soft bigotry of low expectations, strengthening families and fostering new economic opportunity? How to urge our representatives in government to set an example for bipartisanship and address fundamental causes of polarization in America? How to inspire more Americans to serve in organizations, like yours, that bring people together from all racial, ethnic, religious and economic backgrounds such that, as happens routinely in our military, where prejudice gives way to understanding, mutual trust, and pride in serving the nation and one another? How to improve civic education to instill pride in the vision of our founders and the uniqueness of our democracy while recognizing, as our founders did, that the American experiment requires constant nurturing and improvement? And of course, as I mentioned at the outset, how to develop a reasoned and sustainable foreign policy to secure freedom, achieve peace, and promote prosperity for generations to come?

As we discuss all of the above, we should give at least equal time to what we agree upon before we clarify areas of disagreement. For example, we might all agree that it is right to express outrage over the murder of George Floyd and police brutality directed against minorities and also agree that it is wrong to use peaceful protests as a cover for destructive violence and criminality. And perhaps what is most in our power is to maintain our military professionalism and, in particular, that bold line between service in our military and partisan politics. Particularly disturbing to me has been the efforts on the part of politicians on both ends of the spectrum to drag the military into partisan disputes, with some suggesting that the military was with one party or another side. Our military fights to defend the freedom and security of all Americans, and we might remember that on 11 September, 2001, Al Qaeda did not attack Republicans or Democrats; they attacked Americans. We are part of a profession in which we are bound together, bound together by an oath to our Constitution. We are called to a mission far larger than ourselves or any micro-identities, including political parties. As leaders, we build cohesive teams bound together by common purpose, mutual respect, and a willingness to sacrifice for our mission, for our nation, and for one another. We are part of organizations in

which the man or woman next to you is willing to give everything, including their own lives, for you. We have no time for prejudice based on race, religion, sexual orientation, or any other category. Good military units take on the qualities of a family in which prejudice and bigotry have no place.

So while we should be concerned about the polarization in our society, we should remain confident in our principles and who we are as a people and who we are as a military profession. We can do our part. We can do our part by maintaining our professionalism, resisting efforts to drag us into partisanship, reaching out to our fellow Americans, and engaging in respectful debates, especially within our military family, about issues important to our future, rejecting demagoguery rooted in ignorance, bigotry and racism, and, of course, supporting it, defending our democracy and the Constitution of the United States.

Thank you. Thank you all of you for what you will do to help our nation rebuild strategic competence, grow our confidence, protect our great experiment in democracy, and create a better future for generations to come. What a privilege it's been to be with all of you, and I look forward to seeing where you'd like to take the discussion. Thank you.

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Hypersonic Weapons: Strategic Drivers and Policy Proposals

Second Lieutenant Jonah S. Bhide

Introduction

Whether it is troop movement across terrain, the performance of military aircraft, or the time required responding with national force, speed has always been a critical element in securing U.S. national security objectives.Indeed, Sun Tzu acknowledged that speed is the essence of war, and an essential component in speed is technology. Emerging technologies influence and alter strategic analyses as they are developed and deployed.

Russian hypersonic weapons have been the most recent to make the news, touting capabilities which can maneuver past missile defense systems.[1] With that in mind, China is also developing this type of weapon system, but the U.S. was the first to test it.These weapons present myriad risks and threats to nuclear deterrence, strategic stability, and crisis stability because of their unique capabilities.

The hypersonic velocity regime is defined by NASA as an object moving between five and 25 times the speed of sound at sea level (Mach 5 to Mach 25).[2] There are two types of hypersonic weapon operating in this speed regime. The first group is air-breathing vehicles which use incoming air towards and through the missile as a means of propulsion. Air-breathing vehicles, or cruise missiles, tend to fly close to the Earth's surface, making them difficult to monitor with current detection technology and methods. The second group of hypersonic weapons is the hypersonic glide vehicles (HGVs). These are launched into the exo-atmosphere with one or more rocket stages before the reentry vehicle is released, and then glides to its target. The rocket-propelled period is referred to as the boost phase; all HGVs use a boost phase and are sometimes called boost-glide vehicles (BGVs).

The HGV name refers to two types of glide: glide and skip-glide. Proceeding from the ballistic phase, the glide vehicle dives and then performs a perigee pull-up maneuver. Depending on design, the vehicle may then enter an equilibrium glide trajectory before diving to the target. Alternative designs will, after pulling up, enter a skip-glide trajectory which allows the RV to bounce across the surface of the upper atmosphere. Given the performance principles of air-breathing hypersonic weapons, such weapons would be subject to the limitations set forth in the INF Treaty and New START as they are unmanned and utilize onboard power plants and lift-generating surfaces together for half or more of the trajectory.[3]

HGVs, on the other hand, do not fully meet either cruise or missile definition. A HGV may use lift and may be unmanned for most of its trajectory but does not utilize a power plant. The HGVs' manipulation of aerodynamic forces to reach the

target and to ensure a stable glide means that HGVs are guided and do not act exclusively under the effects of drag and gravity. The boost-glide trajectory is hence non-ballistic. The brief ballistic moments in HGV trajectories comprise only a fraction of total flight time, not meeting the 50% ballistic parameter in New START.[4] The significance of these facts is that HGVs are unregulated technologies that pose new capabilities and new military threats, raising questions for strategic stability.

This paper will present the strategic reasons for U.S., Chinese, and Russian development and the benefits and risks of both national and foreign hypersonic weapons development. This paper will then provide policy recommendations, ultimately concluding that the U.S. should clearly and cohesively establish a large strategic conventional hypersonic glide vehicle capability and lead foreign developers of similar technologies towards arms control agreements to secure both long-term strategic and crisis stability with Russia and China.

The Strategic Context of Hypersonic Weapons: U.S., Russia, and China

As the capabilities and designs of hypersonic weapons become more refined, consistent, and reliable, the strategic context of their development and use become increasingly critical to the discussion surrounding the political, security, and stability implications.

U.S.

The U.S. development of hypersonic weapon technology was initiated under the Conventional Prompt Global Strike (CPGS) program following other projects exploring conventional strike options.[5] CPGS does not have a formal definition but refers to the capability to strike – without the use of a nuclear warhead – quickly anywhere in the world with great precision. CPGS was developed by President George W. Bush's administration to meet DoD initiatives and needs for swift global strikes, though discussions of such a capability predates the administration. Most prominently, the program spent considerable effort exploring the feasibility of putting conventional warheads on ICBMs, rather than nuclear warheads.[6] General Cartwright in 2006 stated that a small class of targets existed that the U.S. would only be able to eliminate with nuclear warheads, though using such nucelar assets against this small range of targets would be inappropriate.[7] In 2008, the National Academy of Sciences concluded that "high-value targets having time-sensitive urgency could not be effectively engaged by currently available conventional systems",[8] acknowledging that there are a few select types of military targets that could not warrant a nuclear strike but were unreachable by existing non-nuclear options. Under the Bush administration, these types of scenarios would have been targeted with long-range ballistic missiles with conventional warheads, launched from the U.S. or submarines.

That said, the original drivers of CPGS appear to be technological opportunism rather a mission. A 1995 RAND study on conventional ICBMs and SLBMs commented, "Why not [develop the capability]? [It is] Relatively cheap and may be just what we need some day", suggesting such an option should be explored simply because it is possible.[9] Dennis Gormley, moreover, asserts little thought went into what the strategic perceptions in Beijing and Moscow would be if Trident missiles were given conventional warheads.[10] A 2004 Defense Science Board report argued that large sunk costs could be leveraged with existing ICBM and SLBM systems for conventional payload delivery.[11] Technology was the tail wagging the policy dog; as James Acton characterizes early CPGS, it was a "missile in search of a mission".[12]

The Defense Science Board explored multiple scenarios which might require a CPGS option as a response and to close the capability gap between nuclear delivery platforms and conventional means:

1.A near-peer competitor has used an emerging counter-space capability to destroy a U.S. satellite.

2.The U.S. needs to intercept or destroy a package of special nuclear material (SNM) being transported by a terrorist organization while the location is known.

3.The U.S. needs to eliminate an uncharacterized WMD in a static small package while the location is known.

4.Terrorist organization leadership is expected to gather at a certain location, and the U.S. needs to eliminate the meeting participants.

5.The U.S. needs to totally deny a rogue state the capability to deliver any nuclear weapons.[13]

These scenarios framed the CPGS capability as a limited-use, tactical-in-application mission, but the justifications for such a program shifted slightly under the Obama administration. In the 2010 NPR, CPGS became the means to "continue to strengthen conventional capabilities and reduce the role of nuclear weapons in deterring non-nuclear attacks".[14] The Obama administration, under this goal, linked ballistic missile defense development with advanced conventional weaponry. CPGS development during this period, though unimpeded during the transition between administrations, moved away from conventionally modified ICBM/SLBMs and focused on hypersonic weapons. Hypersonic weapons continue to be the main technology pursued by CPGS.

The current and unresolved question is whether CPGS is a niche limited-use program or a strategic-scale platform for high-intensity conflict. Most development objectives and the envisioned uses of the hypersonic weapon technology remain creating a capability for a precise, powerful, small-scale strike on time-sensitive and

difficult-to-reach targets for which no non-nuclear U.S. capability currently exists. The technology is intended for a niche role in U.S. conventional strike capability.[15]

Russia

Unlike the two other nations which are developing hypersonic weapons, Russia's development of the technology is part of recent national and international strategic developments. In the most recent national security strategy white paper put out by the Russian Federation, sovereignty, growth, social stability, cultural integrity, and a competitive economy are its named long-term strategic goals.[16] Most forward, though, is the stated goal of "consolidating the Russian Federation's status as a leading world power, whose actions are aimed at maintaining strategic stability and mutually beneficial partnerships in a polycentric world".[17] Russian thought anticipates a new rise in capability and prestige, and also regaining regional and global influence. *Derzhavnost*, or 'greatpowerness', is a potent and deep-rooted concept in Russian strategic thinking and this notion forms the basis of Russia's national strategies.[18]

Russian acknowledgement of the above factors as elements the military itself will achieve suggests a growing link between military policy and other internal goals. The implication is a strategic recoupling of the military to Russia's core geo-strategic interests and security policy.[19] National strategy, deterrence, strategic stability, and crisis stability hence depend on military means and policy and the degree to which Russia and its institutions desire to assert themselves as a great power.

Russian strategic thought and objectives over the past few years have prioritized operational flexibility while simultaneously denying potential adversaries the same decision-making latitude.[20] Part of this involves developing a robust national defense infrastructure, but not purely in a symmetrical shape to that of the U.S. and NATO. This newer military posture is an offensive defense, and preemptive in character. To Russians, a defense strategy cannot, unlike Western conceptions, cede territory in exchange for decision space in a conflict.[21] Defense strategies and war-planning must be outward looking, while ensuring inviolable border integrity.

Putin has condemned the Bush administration's withdrawal from the Anti-Ballistic Missile Treaty in 2001, creation of a Ballistic Missile Defense Agency, and the Obama administration's implementation of ballistic missile defense systems in Eastern Europe each as destabilizing.[22] [23] [24] While the U.S. claims these systems do not undermine Russian missile capabilities, Russia still considers them threats to its strategic nuclear deterrents.[25] What is more, nuclear weapons are very much a core element in the Russian conception of great powerness.[26] Whether real or a misplaced fearful perception, the implication of an undermined nuclear capability by means of missile defense systems, they suggest a Western aim and ability to limit Russia's claim to great power status.

It is within this strategic context – an offensive defense, ballistic missile defenses at the border, and the U.S. testing of hypersonic weapons – Russia has initiated reforms of its military. Russia anticipates an aerospace theater of military operations that fuses the air and space domains typically considered separate in traditional U.S. schools of thought and has thus made organizational reforms to account for this.[27] The most rigorous reform so far is the creation of the *Vozdushno-kosmicheskie sily* (VKS), or Aerospace Forces, combining the Air Force and the Aerospace Defense Forces.[28] This signals the merging of the air domain with the space domain in Russian strategic thought.

Hypersonic weapons, both glide and cruise vehicles, operate in this domain, and the U.S. CPGS and hypersonic capabilities have driven much of the reasoning for reform.[29] There exists, moreover, widespread disbelief in Russia that the U.S. pursuit of hypersonic weapons is motivated by any state other than Russia, despite the public U.S. discussions of the weapons' use for rogue actors and terrorist scenarios.[30] Indeed, this is why, in addition to the development of Russian hypersonic weapons and defenses, Russia has indicated that a conventional strategic strike by the U.S. could still prompt a nuclear response from Russia.[31]

Specifically, Russia is developing a hypersonic glide vehicle under Project 4202. The platform is otherwise referred to as the Yu-71.[32] This HGV is claimed to be able to penetrate missile defense systems – both in Europe and the U.S..[33] There are plans, furthermore, for the Yu-71 to carry nuclear warheads, in addition to conventional warheads.[34] Russian development of such a system demonstrates that its acquisition is driven by national and military strategies, targeting the threat and obstacles of missile defense systems that would undermine Russian gains in a crisis or war. A hypersonic capability provides Russia an additional means of holding potential adversaries at risk. That said, current Russian capabilities and effectiveness of this platform are still unclear.[35]

Russian reasons for developing hypersonic weapons stem from a strategic need. The merging and re-conception of the air and space domains into the aerospace theater of military operations, and anticipating the need to provide dominant domain control in the maintenance of an offensive defense to ensure territorial integrity, both call for a hypersonic capability. The U.S. development of such penetrating ability has prompted a Russian exploration into the same, and into protection against it (for example, deployment of the S-500 system).[36] The ability to project *derzhavnost*, furthermore, justifies national acquisition of hypersonic weapons. There exists some commentary that hypersonic weapons are part of Russian nuclear modernization. This, however, is not the case; hypersonic weapons development precipitates from greater considerations: strategic need, shifting military thought, and identity assertion.

China

Of the three powers developing hypersonic weapons, open-source information suggests that China has made the most tests and appears to have the most developed program. The purposes and drivers of weapons development, however, are much less clear than the U.S. or Russian cases. That said, China's nuclear and strategic thought may provide insight into the reasons for development and potential applications of hypersonic weapons.

A critical component for Chinese national security strategy and for its armed forces is to "maintain strategic deterrence and carry out nuclear counterattack".[37] This is a straightforward mission with similar goals to U.S. and Russian nuclear enterprises, but Chinese nuclear thinking and strategy tend not to align with such modes of thought. China maintains a no-first-use policy for its nuclear weapons. That is, China has publicly committed itself not to strike first with nuclear weapons in a conflict. This posture and thought originates from China's historical experience with foreign nuclear weapons and its own nuclear capability: the nullification of potential nuclear coercion, or blackmail.

Before China developed nuclear weapons, the U.S. threatened the PRC with nuclear weapons during a conflict with Taiwan.[38] The specter of being coerced into a particular course of action by a nuclear power – blackmail – was unacceptable to Chairman Mao, and the means of preventing such coercion was the acquisition of nuclear weapons for a nuclear second-strike capability.[39] Nuclear weapons, given the purpose of preventing coercion and the massive damage they could inflict during early periods of acquisition, were – and are – not considered particularly useful on the battlefield.[40] Conventional force, active defense, and the people's war are the governing factors in armed victory.[41] This means that China's military growth will depend on two key factors: the survivability of its nuclear deterrent and the conventional strength China aims to deliver. That said, it is important to note that if an adversary's capability credibly and sufficiently threatens China's retaliatory ability, it may be incentivized to use nuclear weapons before it loses the ability to do so.[42]

"China will unswervingly follow the path of peaceful development, pursue an independent foreign policy of peace and a national defense policy that is defensive in nature, oppose hegemonism and power politics in all forms" in its pursuit of the "Chinese Dream" of national rejuvenation, as stated in its 2015 Defense White Paper.[43] Opposition to power politics and hegemonism indicates a resolve to assert regional influence, and this perhaps is best manifested in the strategic requirement of combining the "offshore waters defense" doctrine of the past with the new "open seas protection".[44] China's defense posture is no longer simply concerned with protecting its border but is now looking outward and regionally in power projection

to contend with other regional actors. This requires an increased ability to operate and contend with other naval and military presences, and swift, precise, undetectable anti-ship missiles seem to be a means of achieving this end – a capability a hypersonic missile could easily accomplish.

China believes the U.S.-proposed Terminal High Altitude Area Defense system (THAAD) and other existing regional ballistic missile defense systems undermine its ability to project a conventional capability in the South China Sea. These U.S. missile defense capabilities, moreover, may be able to undermine China's second-strike capability against the U.S. As China's strategy depends on the maintenance of open-seas protection and the survivability of its second-strike capability, regional U.S. missile defenses appear to China as threats to such objectives and may have prompted the development of hypersonic weapons to circumvent such challenges.

A latent nuclear Japan is another strategic threat to China and may also be a strategic driver of hypersonic capability development. Possessing large plutonium stocks, Japan may have the ability to develop a nuclear weapon should the U.S. nuclear umbrella lose credibility.[45] Should such a scenario arise, as may likely be the consequence of successful Chinese assertion in the region, the ability to eliminate a nuclear weapons facility, or to maneuver around a missile defense system placed in Japan, is of great strategic benefit.

The technology lag between U.S. and Chinese advancements may be a strategic fear which China is attempting to mitigate by responding to U.S. tests with a Chinese hypersonic program. China often pursues military and nuclear development efforts to master new technology to avoid lagging. The fear of instability resulting from a technical lag, and the fear of being attacked resulting from lagging behind in the development of military technology, are prominent in the Chinese strategic security paradigm.[46] When the U.S. developed its hypersonic weapons tests, Chinese military and strategy policymakers may have seen such a capability as one with which China could fall behind.

China's development of hypersonic weapons seems to align with strategic goals, in addition to strategic fears of lagging behind in technical development, and the specter of a latent nuclear Japan. That said, the application of DF-ZH seems to be less clear than the cases of U.S. or Russia. The DF-ZH missile may be intended for theater use at sea-based targets, but it may also be developed for long-range applications to hold the U.S. at risk while circumventing missile defense systems.[47] There is, as usual, the possibility of placing a nuclear warhead on the DF-ZH as well.

Strategic Considerations: The Multilateral Dynamic

Foremost, it is important to consider that the United States' hypersonic weapons programs may have spurred the development of other nations' programs; U.S. exploration of the technology raised fears about its capability and intent. Within China, and Russia, the U.S. prompt global strike program – which, as it currently stands, is oriented almost exclusively around hypersonic weapons – is discussed as an inherently pre-emptive and destabilizing system.[48] For those two nations, the U.S. HGV is a strategic weapon, not a limited-use, niche conventional weapon. In turn, this has prompted their development of technology to symmetrically meet their perceived fears of U.S. intentions. While this may imply future destabilizing conditions, the U.S. could do more to communicate the program's intent. Unfortunately, as with the history of CPGS as a whole, the program has not managed its vision and policy direction cohesively and has thus communicated various and conflicting intentions. This is further confounded when public affairs conversations from the DoD and military industry officials cite Chinese and Russian development of hypersonic weapons as a reason for the U.S. to accelerate its own research into the technology, suggesting the weapon is indeed intended to be a strategic platform.[49, 50, 51]

The variance in strategic postures and the governing reasons for hypersonic weapons technology acquisition show that a dyadic conception of deterrence will not guarantee stability. China is developing hypersonic weapons in response to Russia as well as a response to the U.S..[52] The actions the U.S. might take to deter potential escalation, or to respond to evolving scenarios in one region to improve stability, may in fact undermine stability in another. For example, a U.S. symmetrical response to Russian vertical hypersonic weapon proliferation might actually reach a point of strategic and deterrence stability, but such an increase in hypersonic arms would certainly threaten China's confidence in its second-strike capability, prompting their own increased production. This could also create a potential for crisis instability should a crisis arise between the U.S. and China. The implications of a three-actor arms race cannot be ignored.

Benefits of U.S. Development, Acquisition, and Deployment

The U.S. development, acquisition, and deployment of hypersonic weapons technology present, chiefly, two benefits: increased options for various crises and escalatory scenarios, and for increased credibility globally.

Within the increased responsive capability hypersonic weapons provide, the U.S. would be able to strike a located terrorist, much like Osama bin Laden, or a meeting of high-profile insurgency leaders.[53] This seems to be one of the more likely scenarios explored by the Defense Science Board, and hypersonic weapons seem to offer a capability to eliminate the targets outside the operating ranges of U.S. UAVs. Another possible example for hypersonic weapons use is to eliminate a near-peer

competitor's anti-satellite (ASAT) capability, needing to get past air defense and missile defense systems for a precise strike.[54] Perhaps most salient, though, is the ability to strike rogue nuclear states. Should the DPRK or Iran develop a nuclear missile, hypersonic weapons offer the ability to strike these missiles before they leave the launch pad. Within these possible scenarios, hypersonic weapons offer a limited-use means of achieving overarching strategic goals.

Under the policy direction under the Obama administration, hypersonic weapons with conventional – or non-nuclear – configurations offer the opportunity to develop weapons that can act with the same destructive power and precision as tactical nuclear weapons. They also offer a means of reducing U.S. dependence on nuclear weapons as a response to crises.[55] Given their speed and maneuverability, hypersonic weapons enhance the United States' ability to respond credibly to scenarios that require much greater speed and precision than most other U.S. conventional forces can provide.[56] This means that the U.S. nuclear threshold would be raised by the introduction of hypersonic weapons as a response option, eliminating a dichotomy between doing nothing or using a nuclear weapon.[57] Strategically, this improves U.S. credibility for action as a conventional hypersonic weapon strike is substantially more usable than even a tactical nuclear weapon.This improves U.S. posturing and ability to deter regional threats. For this to be an effective increase in credibility in addition to a reduction in nuclear weapons dependence, the number of hypersonic weapons required would be larger than the niche role for which it was initially intended.

A potential, but highly questionable, benefit of hypersonic weapons is the possibility of delivering a nuclear weapon. If missile defense systems have become robust enough to undermine the effectiveness of existing nuclear weapon delivery systems such that a potential adversary cannot be held sufficiently at risk to maintain an effective deterrence relationship, hypersonic delivery of nuclear weapons may help achieve this. It should be noted, though, that this also assigns a strategic role to hypersonic weapons at the same status of ICBMs and SLBMs. Additionally, the nuclear option would likely prompt an imbalanced three-actor delivery vehicle arms race. At best, a nuclear hypersonic weapon would be a strategic benefit for symmetrical deterrence in the distant future – not as a near-term strategic benefit during this period of exploratory testing and development by the U.S., China, and Russia.

Finally, increased research and development of hypersonic capabilities may also improve efforts to develop missile defense systems to protect against the threat foreign hypersonic weapons pose to the U.S..

Strategic Threats and Risks of U.S. and Foreign Development and Deployment

While a few operational benefits exist, with improved credibility, both U.S. and

foreign development of hypersonic weapons technology represent many threats to U.S. interests and national security.

Perhaps most obvious is the threat foreign weapons capabilities pose. With the speed, maneuverability, and difficulties in detection and elimination, foreign hypersonic weapons may be able to hold the U.S. and its assets at risk. Should China and Russia effectively design weapons to reach U.S. borders, U.S. nuclear assets and C4 infrastructure can be eliminated. This may lend a first-strike incentive to potential adversaries, or to the U.S. for fear of losing a nuclear capability in the early stages of a crisis, escalating the conflict.

Beyond these general threats and risks, though, threats to strategic stability also exist due to the ambiguity that hypersonic weapons introduce. James Acton puts forth three main ambiguities of the U.S. CPGS which pose threats to strategic stability: warhead ambiguity, destination ambiguity, and target ambiguity.[58] Warhead ambiguity refers to the uncertainty of the type of warhead launched: is the warhead nuclear or conventional? The damage and escalatory nature of the weapon depend on the warhead launched. A conventional strike will not be as escalatory as a nuclear strike. In the case of China, this could make the difference between responding with symmetrical conventional force, an escalation of conventional force, a cross-domain response, or a nuclear second-strike. The uncertainty around the incoming warhead may alter a nation's decision calculus in how to respond, and this was the basis of Congress not funding the Conventional Trident Modification.[59] This may be less of a consideration, though, if hypersonic weapons strikes are limited – perhaps as a single launch and single strike – as strategic attacks would likely occur at greater numbers.

Destination ambiguity, moreover, is attributed to the highly maneuverable capabilities of hypersonic weapons. A launch by the U.S. towards the DPRK to eliminate a nuclear weapon facility can appear to China as a weapon launched towards China, or at the very least, a weapon which can still change course and target China. Conversely, perhaps the initial launch profile is meant to misleadingly suggest the weapon is headed for the DPRK but is, in fact, headed elsewhere. This ambiguity is further complicated when viewed in combination with warhead ambiguity. The destination country, and the nature of the attack, can drastically impact national decisions on how to respond.

Finally, target ambiguity is another factor in the destabilizing uncertainties hypersonic weapons may pose. Suppose a nation correctly assesses a hypersonic weapon has been launched and is targeting said nation, and suppose it is able to determine the warhead type, uncertainty still exists regarding whether a conventional or nuclear weapons-related target is being pursued.The fact that nuclear weapons can be targeted undermines a nation's confidence in its ability to

respond with a second-strike.

These three ambiguities together independently undermine strategic stability because of the uncertainty they pose for how a potential adversary should respond or interpret a weapons launch; crisis stability depends on ensuring two competitive actors do not have an incentive to strike first.[60] Hypersonic weapons are capable of eliminating ground and underground targets, which would include hardened nuclear weapons facilities. If nuclear weapons can be eliminated by a hypersonic weapons strike, then the receiving end of a strike may conclude that it no longer has a survivable second strike capability with the advent of hypersonic weapons. As discussed earlier, China maintains a second strike nuclear policy, but this may be threatened by hypersonic weapons capabilities. This may prompt China to use nuclear weapons – even to a limited or theater extent – to pre-empt the possibility of the U.S. using hypersonic weapons to eliminate the Chinese nuclear arsenal.

The ability of HGVs to bypass current missile defense systems eliminates the survivability such defenses are intended to secure. Given Russia's past criticism of U.S. withdrawal from BMD agreements, the possibility of U.S. HGVs penetrating Russian defenses undermines crisis stability between the two states as an asymmetrical HGV capability may incentivize a first strike, similar to the China case discussed above; while a conventional U.S. HGV may increase the U.S. nuclear threshold as it represents a conventional option that may otherwise be achieved by a tactical nuclear weapon. Paradoxically, however, the threat of a U.S. HGV may indeed lower a potential adversary's nuclear threshold in an attempt to offset the potential U.S. advantage.

Beyond potential U.S. uses, hypersonic weapons represent a capability which is being increasingly considered critical for national defense. U.S. development of hypersonic weapons technology has stoked Russian and Chinese fears of U.S. intentions and capabilities, prompting their respective exploration of the technology to compete with the U.S.. This exposes the U.S. to the threat and risk of a three-nation arms race. Such a race is naturally less stable than a two-state one, as most recently observed in the Cold War, and may potentially erode crisis stability between any two of the three states. In the best-case scenario of an arms race, the U.S. emerges as the actor with the dominant technology and is able to credibly demonstrate this capability, but the financial burden of doing so is uncertain.The other risk is that either China or Russia ends up with the dominant technology. The threat this poses to U.S. national security is self-evident.

Policy Recommendations

U.S., Chinese, and Russian development of HGVs pose an extensive risk to U.S. national security objectives, but this type of technology has and will continue to be developed; it cannot simply be wished away. If for no other purpose than to keep up

with Chinese and Russian development, the U.S. should continue to explore hypersonic weapons capabilities, but this course of action alone does not reduce the risks of this technology's development. The threats and problems HGVs pose must be addressed head-on, and as such this section proposes a variety of policy options and recommendations.

The first proposition is a test ban. Weapons systems – nuclear warheads, delivery vehicles, or missile defenses – have a deterrent value only when their capabilities are demonstrated through testing. No nation developing hypersonic weapons is currently at a point where it can introduce the system into an active arsenal, but upon operationalizing hypersonic weapons a test ban may be both necessary and feasible.[61] Doing so offers the possibility of mitigating an arms race which could be costly, destabilizing, and result in foreign asymmetric advantages in hypersonic technology development. A test ban additionally offers the ability to limit development by states other than the U.S., Russia, and China, and can mitigate potential concerns on the horizontal proliferation of hypersonic weapons.

A secondary arms control method of reducing the threats posed by HGVs is entering a three-nation ban on long-range HGVs. Limiting the range of HGVs can reduce the target and destination ambiguities by increasing the certainty of where an HGV can strike.

For either of the above to be feasible options, however, the U.S. needs to start confidence-building measures (CBMs) now to develop a basis for negotiations. Unilaterally, this would require the U.S. to publicize launch data recording test subject performance. This may alleviate fears of U.S. capabilities or prompt China and Russia to increase their testing. The former outcome can improve stability and aid in potential negotiations to ensure other parties that the U.S. is not securing an overwhelming weapons capability advantage in a test ban or long-range HGV ban. The latter outcome provides more opportunities for the U.S. to gather information regarding foreign capabilities. Additionally, joint CBMs may strive to develop common detection methods to not only increase U.S., Chinese, and Russian fidelity on tracking hypersonic weapons during flight but also provide a common means of verification should hypersonic arms limitations or arms control regimes arise. The U.S. furthermore should initiate Track 2 and Track 1.5 on the strategic utility these weapons have for each nation developing them.

The U.S. should invest substantially in developing national technical means of detection and tracking. HGVs have very unique flight profiles which can aid in tracking them, but the means of detecting the weapons need to be improved. Satellites that can detect heat signatures of objects in the hypersonic speed regime, and intermittent heat emission patterns indicative of HGV atmosphere "skipping", will be integral to any defenses the U.S. develops against the hypersonic weapons

threat.

Hypersonic missile defenses are critical in minimizing the capability of China and Russia to hold U.S. targets at risk. Kinetic kill vehicles (KKVs) are the current anti-ballistic missile defense method: a warhead is launched to destroy an incoming ballistic missile with kinetic energy alone. This is sufficient when eliminating weapons on a ballistic trajectory as such flight paths are predictable. Hypersonic weapons' high-maneuverability renders KKVs almost useless. That said, KKVs launched in succession may be able to force an HGV to change its trajectory or even force the HGV to take a trajectory which moves it away from the intended target. Developing this method of missile defense against hypersonic weapons may serve as an effective interim defense. Given the current difficulties which exist in transmitting data to and from a launched HGV for tracking and control, jamming – with long-range ground-based technologies or airborne platforms – may offer viable long-term defenses against HGVs. Long-term missile defense development will also need to explore directed energy methods for missile defense and HGV elimination, and exploration into multi-domain anti-HGV methods is a critical requirement for future defenses.

Most importantly, the U.S. needs to determine and explicitly communicate the role it envisions for its hypersonic weapons. The most problematic element of the U.S. program's history is the lack of clarity for the weapon's purpose, which has contributed to foreign development of hypersonic weapon technology. Generally speaking, there are three potential roles the U.S. can assign hypersonic weapons: niche use, large conventional use, and nuclear-exclusive delivery vehicle.

The niche use is simply a continuation of CPGS's original justification of hypersonic weapons: elimination of time-sensitive and high-value targets with a conventional warhead. This would likely involve limited development and use of HGVs to eliminate specialized targets and would require the U.S. to accept that other nations will develop HGVs for strategic purposes against the U.S.. Likewise, simply having this HGV capability exposes the U.S. to potential foreign misperceptions of a U.S. hedging strategy for its hypersonic weapons.

There are, alternatively, two nuclear-related options. The U.S. could pursue a nuclear-only option, which would posture the U.S. to only use nuclear warheads on its hypersonic delivery vehicles. This would eliminate the question of warhead ambiguity and offer the U.S. a means of penetrating current missile defenses. Crisis stability, target ambiguity, and destination ambiguity will each remain substantial concerns with the nuclear-only option, potentially undermining strategic stability. Additionally, the nuclear-only option would make hypersonic weapons subject to existing U.S. nuclear-use thresholds, maintaining the very capability gap CPGS aimed to eliminate in exploring hypersonic weapons. The other nuclear option –

dual-use – is the least desirable strategy the U.S. could pursue. This is the most destabilizing option as it conflicts with earlier official U.S. statements regarding the weapons and perpetuates the warhead, target, and destination ambiguities.[62]

Departing from the original CPGS direction of hypersonic weapons development, the U.S. could alternatively pursue a large strategic force of conventional payload hypersonic weapons. This strategy for the weapon presents the U.S. usable HGVs to fulfil strategic ends, be it elimination of multiple battlefield targets, pre-emptive strike, or to disable a nuclear arsenal. Strategic and crisis stability concerns will persist as this conventional capability may undermine foreign nuclear capabilities. This is the most straightforward option and in combination with the CBMs and arms control suggestions, is the most feasible option for securing national security objectives and meeting the threat posed by foreign programs.

Conclusion

The development of hypersonic weapons by China, Russia, and the U.S., and the strategic implications of such technology readily demonstrate the challenges of an increasingly multi-polar world the U.S. must overcome. The prospect of a three-nation arms race cannot be overlooked; the world has not seen a multi-polar arms race of similar magnitude since before the First World War.

In pursuing hypersonic weapons, the U.S. should develop the weapon as a conventional delivery vehicle to serve strategic purposes. But it cannot pursue this, or any other hypersonic weapon strategy, without also anticipating the potential for an arms race and arms control negotiations. Such negotiations present an opportunity for the U.S. to develop a hypersonic offensive and deterrent capability while also exercising global influence in leading the way towards arms control agreements on the same technology.

Policymakers must also note that hypersonic weapon development will not mimic the development of ICBMs and subsequently anti-ballistic missile defenses during the Cold War. Hypersonic weapons development and missile defenses against such are being developed concurrently, and this will have significant impacts on crisis stability and the maintenance of strategic stability in the long run. Moreover, hypersonic weapons stress the importance of developing directed energy missile defenses; KKVs may quickly become an out-of-date paradigm.

Above all, the U.S. needs to consider the strategic implications of its technology development and acquisition programs. Under CPGS, hypersonic weapons tests prompted Chinese and Russian exploratory reciprocations out of fear of U.S. potential uses. Acquisition and development programs for hypersonic weapons should have anticipated this, but they did not, and it has led not only to a small disadvantage in terms of development progress but also in terms of generating

relevant strategic policy.

While hypersonic weapons present a significant disruption to current strategic policy and stability globally, the U.S. should clearly and cohesively establish a large strategic conventional hypersonic weapons arsenal and lead foreign developers of similar technologies towards arms control agreements to secure long-term strategic and crisis stability with Russia and China.

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Notes

1. Chris Baynes, "Russia Tests Hypersonic Missile It Says 'Cannot Be Stopped by Any Defence System'" (The Independent, March 11, 2018).

2. "Mach Number," NASA, accessed April 10, 2018, https://spaceflightsystems.grc.nasa.gov/education/rocket/mach.html.

3. US-Russ., "Protocol to the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms," Pub. L. No. Senate Treaty Doc 111-5, Part 1, Paragraph 10 (2010), http://www.state.gov/documents/organization/140047.pdf.

4. *Ibid*., Part 1, Paragraph 6.

5. Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues" (Congressional Research Service, February 3, 2017), 1.

6. James Acton, "Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike" (Carnegie Endowment for International Peace, 2013), 11.

7. M. Elaine Bunn and Vincent Manzo, "Conventional Prompt Global Strike: Strategic Asset or Unusable Liability?," *INSS Strategic Forum*, no. 263 (February 2011): 4.

8. *US Convnetional Prompt Global Strike: Issues for 2008 and Beyond*(Washington D.C, US: National Academy Press, 2008), 61.

9. Richard Mesic, Roger Molander, and Peter Wilson, "Strategic Futures: Evolving Missions for Traditional Strategic Delivery Vehicles" (RAND, 1995).

10. Dennis Gormley, "Nuclear Disarmament and Russian Perceptions of US Conventional Superiority,"*Security Challenges Journal*6, no. 4 (Summer 2010): 89.

11. "Future Strategic Strike Forces" (Defense Science Board, February 2004), 5–11.

13. "Future Strategic Strike Forces", 2

14. "Nuclear Posture Review Report" (Department of Defense, April 2010), 17.

15. Rachel Weiner, "The Impact of Hypersonic Glide, Boost-Glide, and Air-Breathing Technologies on Nuclear Deterrence," in *Project on Nuclear Issues: A Collection of Papers from the 2016 Nuclear Scholars Initiative and PONI Conference Series*(Center for Strategic and International Studies, 2017), 141.

16. Russian Federation, "The Russian Federation's National Security Strategy" (Moscow, Russia, December

2015), Clause 30.

17. Russian NSS, Clause 30.

18. Bettina Renz and Hannah Smith, "Russia and Hybrid Warfare - Going Beyond the Label," Working Paper, Aleksanteri PApers (Helsinki, Finland: University of Helsinki, 2016), 15.Asserting greatpowerness is different from, and should not be confused with, erroneous claims that Putin and the Russian elite are trying to "rebuild" the USSR.

19. Stephen Covington, "The Culture of Strategic Thought Behind Russia's Modern Approaches to Warfare," Defense and Intelligence Projects (Cambridge, Massachusetts: Belfer Center for Science and International Affairs, October 2016), 39.

20. *Ibid*., 40

21. *Ibid*., 42

22. Terrence Neilan, "Bush Pulls Out of ABM Treaty; Putin Calls Move a Mistake" (New York Times, December 13, 2001).

23. Thomas Shanker and Mark Landler, "Putin Says US Is Undermining Global Security" (New York Times, February 11, 2011).

24. Andrew Kramer, "Russia Calls New US Missile Defense System a 'Direct Threat'" (New York Times, May 12, 2016).

25. Kier Giles, "Assessing Russia's Reorganized and Rearmed Military" (Carnegie Endowment for International Peace, May 3, 2017), 10.

26. Andrew Futter and Benjamin Zala, "Advanced US Conventional Weapons and Nuclear Disarmament,"*The Nonproliferation Review*20 (2013): 111, http://dx.doi.org/10.1080/10736700.2012.761790.

[27. Timothy Thomas,*Russia Military Strategy: Impacting 21st Century Reform and Geopolitics*(Fort Leavenworth, Kansas: Foreign Military Studies Office, 2015), 177.

28. Gudrun Persson, "Russian Military Capability in a Ten-Year Perspective - 2016" (Stockholm: Swedish Defense Research Agency, December 2016), 32.

29. TimothyThomas, 182.

30. James Acton, "Russia and Strategic Conventional Weapons: Concerns and Responses,"*The Nonproliferation Review*22, no. 2 (2015): 145.

31. "Russia Warns of Nuclear Response to US Global Strike Program" (Sputnik News, December 11, 2013).

32. Nik Martin, "Russia's Hypersonic Missile Ratchets up Arms Race" (Deutsche Welle, March 29, 2017).

33. Agency, 2017), 77.

34. Weiner, 142

35. Pavel Podvig, "Summary of the Project 4202 Developments,"*Russian Strategic Nuclear Forces* (blog), June 16, 2015.

36. "Russian S-500 Prometheus Ballistic Missile Defense to Be Deployed in 2016" (RT News, April 15, 2016).

37. "China's Military Strategy (2015)" (The State Council Information Office of the People's Republic of China, May 2015). Subsequent footnotes for this source will refer to the document as "China DWP 2015"

38. Thomas Fingar and Jishe Fan, "Ties That Bind: Strategic Stability in the US-China Relationship,"*The Washington Quarterly* 36, no. 4 (Fall 2013): 126.

39. Chong Liu, "The Relationship Between Nuclear Weapons and Conventional Military Conflicts," in *Understanding Chinese Nuclear Thinking*, ed. Bin Li and Zhao Tong (Washington D.C, US: Carnegie Endowment for International Peace, 2016), 152.

40. *Ibid.*,153

41. China DWP 2015.

42. Caitlyn Talmadge, "Would China Go Nuclear?Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States,"International Security41, no. 4 (Spring 2017): 90.

43. China DWP 2015.

44. Ibid.

45. "Japan," Nuclear Threat Initiative, February 2017, http://www.nti.org/learn/countries/japan/.

46. RiQiang Wu, "How China Practices and Thinks About Nuclear Transparency," in Understanding Chinese Nuclear Thinking, ed. Zhao Tong and Bin Li (Washington D.C, US: Carnegie Endowment for International Peace, 2016), 246.

47. Lora Saalman, "Factoring Russia into the US-Chinese Equation on Hypersonic Glide Vehicles" (Stockholm International Peace Research Institute, January 2017), 5.

48. Ibid.,4.

49. http://www.af.mil/News/Article-Display/Article/1177338/accelerating-hypersonics-development/.

50. Guy Norris, "Raytheon Invests in Technology to Meet Hypersonic Threats" (Aviation Week, June 20, 2017), http://aviationweek.com/paris-air-show-2017/raytheon-invests-technology-meet-hypersonic-threats.

51. "A Threat to America's Global Vigilance, Reach, and Power-High-Speed, Manuevering Weapons: Unclassified Summary" (Washington D.C., US: National Academies Press, 2016), 1, DOI: 10.17226/23667.

52. Salmaan, 3.

53. "Time Critical Conventional Strike from Strategic Standoff" (Defense Science Board, April 2007), 77.

54. Ibid.,65.

55. Futter & Zala, 107.

56. US Convnetional Prompt Global Strike: Issues for 2008 and Beyond, 4.

57. Ibid.,70.

58. Acton, "Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike," 111.

59. Ibid.,113.

60. James Acton, Elbridge Colby, and Michael Gerson, "Reclaiming Strategic Stability," in Strategic Stability: Contending Interpretations(Carlisle Barracks, PA: Strategic Studies Institute and US Army War College Press, 2013), 216.

61. Rajaram Nagappa, "Going Too Fast: Time to Ban Hypersonic Missile Tests?,"Bulletin of the Atomic Scientists 71, no. 5 (2015): 10–11.

62. Ibid.

Bibliography

"A Threat to America's Global Vigilance, Reach, and Power-High-Speed, Manuevering Weapons: Unclassified Summary." Washington D.C., US: National Academies Press, 2016. DOI: 10.17226/23667.

Acton, James. "Russia and Strategic Conventional Weapons: Concerns and Responses."*The Nonproliferation Review*22, no. 2 (2015): 141–54. http://dx.doi.org/10.1080/10736700.2015.1105434.

"Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike." Carnegie Endowment for International Peace, 2013.

Acton, James, Elbridge Colby, and Michael Gerson. "Reclaiming Strategic Stability." In *Strategic Stability: Contending Interpretations*, 117–46. Carlisle Barracks, PA: Strategic Studies Institute and US Army War College Press, 2013.

Baynes, Chris. "Russia Tests Hypersonic Missile It Says 'Cannot Be Stopped by Any Defence System.'" The Independent, March 11, 2018. https://www.independent.co.uk/news/world/europe/russia-tests-hypersonic-missile-kinzhal-vladimir-putin-nuclear-weapons-donald-trump-a8250796.html.

"China's Military Strategy (2015)." The State Council Information Office of the People's Republic of China, May 2015. http://www.china.org.cn/china/2015-05/26/content_35661433.htm.

Covington, Stephen. "The Culture of Strategic Thought Behind Russia's Modern Approaches to Warfare." Defense and Intelligence Projects. Cambridge, Massachusetts: Belfer Center for Science and International Affairs, October 2016.

Elaine Bunn, M., and Vincent Manzo. "Conventional Prompt Global Strike: Strategic Asset or Unusable Liability?" *INSS Strategic Forum*, no. 263 (February 2011).

Evans, Sharon. "Accelerating Hypersonics Development." US Department of the Air Force, May 9, 2017. http://www.af.mil/News/Article-Display/Article/1177338/accelerating-hypersonics-development/.

Fingar, Thomas, and Jishe Fan. "Ties That Bind: Strategic Stability in the US-China Relationship."*The Washington Quarterly* 36, no. 4 (Fall 2013): 125–38. http://dx.doi.org/10.1080/0163660X.2013.861718.

Futter, Andrew, and Benjamin Zala. "Advanced US Conventional Weapons and Nuclear Disarmament."*The Nonproliferation Review* 20 (2013): 107–22. http://dx.doi.org/10.1080/10736700.2012.761790.

"Future Strategic Strike Forces." Defense Science Board, February 2004.

Giles, Kier. "Assessing Russia's Reorganized and Rearmed Military." Carnegie Endowment for International Peace, May 3, 2017.

Gormley, Dennis. "Nuclear Disarmament and Russian Perceptions of US Conventional Superiority."*Security Challenges Journal* 6, no. 4 (Summer 2010): 83–101.

"Japan." Nuclear Threat Initiative, February 2017. http://www.nti.org/learn/countries/japan/.

Kramer, Andrew. "Russia Calls New US Missile Defense System a 'Direct Threat.'" The New York Times Company, May 12, 2016. https://www.nytimes.com/2016/05/13/world/europe/russia-nato-us-romania-missile-defense.html.

Liu, Chong. "The Relationship Between Nuclear Weapons and Conventional Military Conflicts." In*Understanding Chinese Nuclear Thinking*, edited by Bin Li and Zhao Tong, 149–70. Washington D.C, US: Carnegie Endowment for International Peace, 2016.

"Mach Number." NASA. Accessed April 10, 2018. https://spaceflightsystems.grc.nasa.gov/education/rocket/mach.html.

Martin, Nik. "Russia's Hypersonic Missile Ratchets up Arms Race." Deutsche Welle, March 29, 2017. http://www.dw.com/en/russias-hypersonic-missile-ratchets-up-arms-race/a-38189763.

Mesic, Richard, Roger Molander, and Peter Wilson. "Strategic Futures: Evolving Missions for Traditional Strategic Delivery Vehicles." RAND, 1995.

Nagappa, Rajaram. "Going Too Fast: Time to Ban Hypersonic Missile Tests?"*Bulletin of the Atomic Scientists* 71, no. 5 (2015): 9–15.

Neilan, Terrence. "Bush Pulls Out of ABM Treaty; Putin Calls Move a Mistake." The New York Times Company, December 13, 2001. http://www.nytimes.com/2001/12/13/international/bush-pulls-out-of-abm-treaty-putin-calls-move-a-mistake.html.

Norris, Guy. "Raytheon Invests in Technology to Meet Hypersonic Threats." Aviation Week, June 20, 2017. http://aviationweek.com/paris-air-show-2017/raytheon-invests-technology-meet-hypersonic-threats.

"Nuclear Posture Review Report." Department of Defense, April 2010.

Persson, Gudrun. "Russian Military Capability in a Ten-Year Perspective - 2016." Stockholm: Swedish Defense Research Agency, December 2016.

Podvig, Pavel. "Summary of the Project 4202 Developments."*Russian Strategic Nuclear Forces* (blog), June 16, 2015. http://russianforces.org/blog/2015/06/summary_of_the_project_4202_de.shtml.

Renz, Bettina, and Hannah Smith. "Russia and Hybrid Warfare - Going Beyond the Label." Working Paper. Aleksanteri PApers. Helsinki, Finland: University of Helsinki, 2016.

"Russia Military Power: Building a Military to Support Great Power Aspirations." US Defense Intelligence Agency, 2017. http://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20 Report%202017.pdf.

"Russia Warns of Nuclear Response to US Global Strike Program." Sputnik News, December 11, 2013. https://sputniknews.com/military/20131211185462951-Russia-Warns-of-Nuclear-Response-to-US-Global-Strike-Program/.

Russian Federation. "The Russian Federation's National Security Strategy." Moscow, Russia, December 2015.

"Russian S-500 Prometheus Ballistic Missile Defense to Be Deployed in 2016." RT News, April 15, 2016. https://www.rt.com/news/339757-s-500-prometheus-air-defense/.

Saalman, Lora. "Factoring Russia into the US-Chinese Equation on Hypersonic Glide Vehicles." Stockholm International Peace Research Institute, January 2017. https://www.sipri.org/publications/2017/sipri-insights-peace-and-security/factoring-russia-us-chinese-equation-hypersonic-glide-vehicles.

Shanker, Thomas, and Mark Landler. "Putin Says US Is Undermining Global Security." The New York Times Company, February 11, 2011. https://www.nytimes.com/2007/02/11/world/europe/11munich.html.

Talmadge, Caitlyn. "Would China Go Nuclear?Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States."*International Securityb*41, no. 4 (Spring 2017): 50–92. https://doi.org/10.1162/ISEC_a_00274.

Thomas, Timothy.*Russia Military Strategy: Impacting 21st Century Reform and Geopolitics*. Fort Leavenworth, Kansas: Foreign Military Studies Office, n.d.

"Time Critical Conventional Strike from Strategic Standoff." Defense Science Board, April 2007.

US Convnetional Prompt Global Strike: Issues for 2008 and Beyond. Washington D.C, US: National Academy Press, 2008. http://www.nap.edu/catalog/12061.html.

US-Russ. Protocol to the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, Pub. L. No. Senate Treaty Doc 111-5, § Part 1, Paragraph 6 (2010). http://www.state.gov/documents/organization/140047.pdf.

Weiner, Rachel. "The Impact of Hypersonic Glide, Boost-Glide, and Air-Breathing Technologies on Nuclear Deterrence." In*Project on Nuclear Issues: A Collection of Papers from the 2016 Nuclear Scholars Initiative and PONI Conference Series*, 136–60. Center for Strategic and International Studies, 2017.

Woolf. "Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues." Congressional Research Service, February 3, 2017.

Wu, RiQiang. "How China Practices and Thinks About Nuclear Transparency." In*Understanding Chinese Nuclear Thinking*, edited by Zhao Tong and Bin Li, 219–51. Washington D.C, US: Carnegie Endowment for International Peace, 2016.

Deterring Terrorist Organizations in Times of a Global Pandemic: An argument for an indirect approach to deterring terrorism

Grant Van Robays*

Introduction

The COVID-19 pandemic has disrupted nearly every facet of life across the world. While the United States is the world's social, economic, and political powerhouse, it is no exception to the indiscriminate virus. The U.S. faces economic volatility, social unrest, political polarization, and a devastating loss of American life due to the pandemic. To make matters worse, these crises leave the U.S. vulnerable to opportunist terrorist organizations at home and abroad, who may seek to take advantage of these vulnerabilities, whether perceived or real. While the pandemic appears to be slowing down both in the U.S. and abroad, the vulnerabilities to the economy and social and political arenas can persist long after the last positive COVID test. History shows that pandemics are not merely a one-time occurrence, meaning there will almost surely be another in the future. When this occurs, vulnerabilities will again present themselves and open doors for opportunist terrorist organizations to attack. Thus, it is imperative to explore new terrorist deterrence strategies, particularly strategies catered towards global pandemics and the chaos they invite. To explore the question of "Can we deter terrorists from exploiting the pandemic?" this paper first asks, "Do vulnerabilities in an established regime brought on by pandemics invite circumstances of opportunity for terrorist organizations? If so, how can a power like the U.S. deter terrorists from taking advantage of these vulnerabilities?

Objectives and Hypotheses

This paper investigates these research questions in pursuit of three main objectives. First, the paper will establish that vulnerabilities brought on by global pandemics invite circumstances of opportunity for terrorist organizations. It will also explore deterrence strategies against terrorists that may be applicable to times of global health crises. Thirdly, this paper will argue in favor of a more indirect approach to terrorist deterrence; one that emphasizes the maintenance of resilient health, governmental, and economic institutions to minimize the exploitable vulnerabilities in the U.S. sociopolitical system. I hypothesize that if the U.S. practices this resiliency, terrorist organizations will have fewer opportunities to act on perceived vulnerabilities during times of global pandemics.

Procedure

This paper will rely on open-source information such as academic literature and

publications to investigate the research question and hypothesis. I will draw on research regarding terrorism, counterterrorism, and the logic of terrorist organizations to establish that terrorists may seek to capitalize on vulnerabilities in U.S. society because of the pandemic. To establish that these vulnerabilities exist, I will explore economic data from U.S. publications or nongovernmental financial institutions. To provide support for my hypothesis, I will rely on available deterrence literature to build a framework from which I will expand my argument. This paper looks at the United States' current situation in the pandemic through a lens that asks, "What vulnerabilities exist?" and "What are some ways our government can fix them?" to best protect the American people. In short, I will use available qualitative resources rather than a statistical analysis to construct a unique, theoretical strategy to terrorist deterrence during pandemics.

Potential Vulnerabilities Wrought by the Pandemic

The COVID-19 pandemic has ravaged virtually every country in the world, regardless of wealth, development, or government type. At the time of writing, the global death toll sits at nearly 2.7 million out of 121 million infections.[1] The impact on the United States is nothing short of devastating, amounting to over 537,000 deaths out of nearly 30 million cases.[2] The sheer loss of life from this pandemic is incalculable. However, as crippling as this pandemic has been on the U.S. and around the world, this does not preclude extremists or terrorist groups from taking advantage of the vulnerabilities wrought by the pandemic. This paper must first define vulnerability. In simple terms, vulnerability is the state or quality of being vulnerable.[3] Vulnerable, a derivation from the Latin "vulnus," meaning wound, originally meant capable of being physically wounded, but can be used figuratively to suggest a defenselessness against non-physical attacks.[4] Altogether, a vulnerability can be conceptualized as the state of being at susceptible to attack or wounding. The wound can be physical, emotional, psychological, economic, political, or social. This paper will consider vulnerability in this broad sense, considering the weaknesses, tangible or otherwise, created or exacerbated by the global pandemic.

The pandemic has contributed to a drastic economic downturn. As the pandemic spread, many businesses shuttered and had to reduce staff to cut their losses, while other jobs were moved online when applicable. According to a May 2020 publication by the Congressional Budget Office (CBO), the social distancing measures taken to curtail the spread of the COVID-19 virus have "widely disrupted economic activity, causing a wave of job losses and ending the longest expansion since World War II."[5] The unemployment rate skyrocketed from 3.8 percent in February 2020 to 14.4 percent in April 2020, as nearly 14 million Americans lost their jobs.[6] These figures surpass the Great Recession of 2007-2009, which pushed the unemployment rate to nearly 11 percent.[7] However, the labor market is projected to improve gradually throughout 2021 as vaccination rollout improves,

hiring rebounds, and job losses drop significantly, according to the CBO.[8] These improvements will not be large enough to make up for earlier losses, though, as the 2021 real GDP is projected to be 1.6 percent lower and the unemployment rate 5 percent higher in the fourth quarter than their respective values in 2019.[9] Recent projections from the Congressional Budget Office show a comparatively more positive economic outlook. Real GDP will return to its previous peak level in mid-2021 and will continue to expand at a 2.5 percent annual rate until 2025 due to a strong rebound in consumer spending and reinvestment in business hurt by the pandemic.[10] The CBO projects consumer spending to grow at an average annual rate of 2.8 percent until 2025; however, this projection is inhibited by lasting effects of unemployment, reduced labor income and lasting caution by consumers.[11] The unemployment rate is projected to decline gradually to below the natural rate of unemployment in 2024 and reach 4 percent by 2025, which is on par with the pre-pandemic unemployment rate.[12] However, the CBO notes that their projections contain a substantial degree of uncertainty due to government policies, vaccine distribution/efficacy, and consumer attitudes and behaviors. Additionally, a virulent variant of COVID-19 can manifest and reinforce social distancing measures and more economic disruption.[13] There is also the possibility that economic output may decline and stall the recovery process. The pandemic has had disparate effects on different industries and populations, which provides uncertainty for long-term productivity projections.[14] Finally, the increase in domestic and global debt in turn increases the risk that financial instability in only a couple countries can severely impact many countries due to the globalization of markets.[15]

The U.S. economy has rebounded well to the initially devastating economic impacts of COVID-19, as the CBO projections indicate. By their estimates, the U.S. economy and labor force will approach pre-pandemic figures by the year 2025. This paper does not aim to argue that the U.S. economy is in shambles or that it is not able to recover from the pandemic. Rather, it argues that the uncertainty within the U.S. economy serves as a potential source of vulnerability, perhaps an exploitable one. According to the CBO projections, the economy may not reach pre-pandemic figures in respect to unemployment and real GDP growth until a year or two from now, which may contribute to a wide sense of economic uncertainty. Economic uncertainty and an ever-expanding federal and global debt can be a source of vulnerability on behalf of consumers and the national economy. It is unclear if this economic uncertainty and vulnerability significantly heighten the risk for terrorist attacks. A 2018 analysis of terrorism in Tunisia by Nurunnabi and Sghaier, researching the socioeconomic determinants of terrorism, found that a 1% increase in the unemployment rate increases the number of terrorist attacks by .24 percent. Nurunnabi and Sghaier also found that a 1 percent increase in political instability increases the number of terrorist attacks by 1.02 percent.[16] The rationale behind these results is that politically unstable countries may offer favorable conditions for

the spread of terrorism.[17]

The results of Nurunnabi and Sghaier's analysis share commonalities with those of Staub, who found that higher unemployment rates lead to an increase in terrorist attacks.[18] Their findings also indicate that increases in GDP per capita have a negative impact on terrorism.[19] This notion contrasts to the findings of Piazza,[20] who discovered that the level of economic development (operationalized by gross national income and the Human Development Index) has a significantly positive impact on domestic terrorism, suggesting that more modernized countries offer more targets for terrorists and more means to plan and act.[21] This finding align with the results of Estrada et al., who revealed a positive relationship between GDPs per capita and terrorism. Ismail and Amjad found that unemployment, inequality, and political repression have insignificant impacts on terrorist activity in the long term.[22] [23] Thus, the actual relationship between economic growth and unemployment remains gray, with evidence that both supports and disproves the notion that economic growth decreases the risk of terrorism. This paper does not intend to present new evidence in favor of either side but intends to explore the relationship between the economy and threats of terrorism to identify threats to the U.S. during the pandemic. However, an uncertain economy compounded by political and social division can result in serious instability, and the resulting vulnerability is significant and must be considered.

The pandemic has become a highly politicized and polarized issue in the U.S. Since the early days of the pandemic, Republican Party officials have tended to downplay the severity of the virus, whereas Democratic leaders have urged more caution.[24] Republicans generally engaged in less social distancing compared to Democrats, according to GPS data on smartphones.[25] Media outlets on each side of the political spectrum have also sent divergent messages on the pandemic and its severity, following a pattern of a hyper-partisan media.[26] After a tumultuous election cycle in 2020, partisanship has hardly subsided. The 2020 election results were highly contested by the incumbent Republican president and certain Republican members of Congress. This partisanship culminated in a siege at Capitol Hill on 6 January, 2021 by domestic terrorists and supporters of the former president.[27] An unclassified summary from the Office of the Director of National Intelligence has also indicated that domestic violent extremists motivated by a range of ideologies are likely to be galvanized by political and societal events from this past year.[28] Thus, hyper-partisanship and polarization are not a new phenomenon, rather one that has deepened in the recent months and years and may continue to deepen. Public opinion surveys attest to this, as the share of Americans from both parties who view members of the other party as "cold" on a feeling thermometer has risen from about 60 percent in 2016 to a little over 80 percent in 2019.[29] Survey results have shown that people from opposing parties increasingly view the other party as close-minded and unpatriotic.[30] The global health crisis and the 2020 election have

exacerbated existing political and social tensions in the United States, posing a significant vulnerability to the country. Domestic terrorist and extremist groups may, as the ODNI assessed, escalate their plans and attacks to take advantage of a polarized climate. International extremist groups may also take advantage of a divided United States, as their weakening social structures and trust in government may present an opportunity too rife to pass up.

Another domain in which the U.S. may be vulnerable to attack is cyber. As the pandemic spread across the country, countless shutdowns and closures took place in response. Jobs, education, and businesses moved online when possible, providing more opportunities for cybercriminals to take advantage of increased security vulnerability. An INTERPOL assessment reported an uptick in cybercrime activities, with over 900,000 spam messages, 737 incidents related to malware, and 48,000 malicious URLs all related to COVID-19 between January and April of 2020.[31] INTERPOL projected an increase in cybercrime in the future because vulnerabilities related to working at home and the potential for increased financial benefit will motivate cybercriminals.[32] As COVID-19 case numbers decrease with an increased distribution of vaccines, INTERPOL assesses that there will be another spike in phishing related to these medical products.[33] Put simply, the fear and uncertainty created by the pandemic provide a golden opportunity for cybercriminals to exploit.

There are many ways in which cybercriminals have utilized the online domain for personal gain during the pandemic. The same INTERPOL assessment addressed five different strategies deployed by cybercriminals. Online scams and phishing are the most common and consist of actors impersonating government and health authorities to entice victims into providing their personal data. Cybercriminals are also using more disruptive malware against critical infrastructure, government, and healthcare institutions. Cyberattacks and disruptive malware against critical infrastructure have a high impact and significant financial benefit for the hacker.[34] The U.S. healthcare system is not immune to these attacks by any means, as an estimated 26 million patient records were exposed to unauthorized parties in the U.S. in 2020, with about 24.1 percent of those resulting from healthcare cyberattacks.[35] Cybercriminals also have deployed data-harvesting malware and spyware, in which criminals use COVID-19 information as a lure to infiltrate and compromise networks and steal personal data. There has also been a significant increase in malicious domain usage, whereby criminals use fraudulent websites with COVID to attack victims, who are then subject to a variety of malicious activities like malware deployment and phishing. The INTERPOL assessment reported a 569 percent growth in malicious registrations from February to March 2020, and a 788 percent growth in high-risk registrations in the same time period.[36] Finally, cybercriminals can easily spread unverified misinformation about the virus and vaccines.

The INTERPOL assessment on cybercrime during the pandemic and the hacks on U.S. healthcare infrastructure highlight a significant vulnerability and opportunity for cybercriminals, both at home and abroad. The importance of this vulnerability and the need for a secure cyberspace cannot be understated, as cybersecurity is an essential component of a safe and secure society. The U.S. Department of Homeland Security reiterates this message and has stated on its website that "our daily life, economic vitality, and national security depend on a stable, safe, and resilient cyberspace."[37] While there has yet to be a cyberterrorist attack or insurgency through cyberspace, the U.S. must consider the possibility that they can and will happen. As society continues to work and learn online for the duration of the pandemic, cybercriminals and organizations with expanding capabilities can feasibly jump the opportunity to attack critical infrastructure in the U.S. or spread misinformation or disinformation. The reality of the latter is already well-documented, as recent reports show online platforms directed by Russian intelligence are spreading disinformation about COVID-19 vaccines used in the U.S.[38]

Perhaps one of the most logical and dangerous targets for cybercriminals is the U.S. power grid. All 16 sectors of the U.S. economy that make up the country's critical infrastructure rely on access to electricity.[39] Disabling the power grid would therefore be extremely serious and could impact basic government and social services and institutions. While an attack on the grid would require intensive planning and capabilities that many criminal or terrorist organizations simply do not have, the possibility of an attack cannot be entirely ruled out, especially after a cyberattack in Ukraine. In December 2015, a synchronized and expertly executed cyberattack caused a six-hour blackout for hundreds of thousands of people in and around Kiev.[40] Forensic evidence and geopolitical circumstances tied the attack to Russian hackers from a group called Sandstorm.[41] During the outage, hackers took control of the computers of Ukraine's main power companies, disabled backup power supplies, sabotaged operator workstations, and implemented malware that wiped out essential files.[42] The "BlackEnergy" malware used in this case has been used by Sandstorm in their targeted attacks against industrial control systems in Ukraine, the U.S., and NATO.[43] Sandstorm has been active since 2010 and has used BlackEnergy malware to disrupt operations at major businesses and government officials since 2011 with the knowledge or consent of the Russian government.[44] U.S. Navy Admiral Michael S. Rogers stated that the probable goal of the large-scale 2015 attack was to watch the response and learn how to slow it down in the future.[45] In other words, this cyberattack was a well-executed trial run.

This cyberattack was not a one-off or a profit-driven plot, rather an act of coordinated destruction. Coordinated destruction, as defined by Tilly, is when persons or organizations that specialize in coercive means undertake a program of damage to persons/objects.[46] The Sandstorm cyberattack on Ukraine fits this

definition because the hacker collective specializes in coercive, albeit unconventional, means of inflicting damage through cyberspace. Cyberspace has few rules of operation or oversight, allowing Sandstorm and other political entrepreneurs to activate boundaries (Russia-Ukraine, in this case) and coordinate an attack. This cyberattack may also fall under a sub-category of coordinated destruction called conspiratorial terror. This is when a small, well-organized set of actors begin attacking more powerful targets by clandestine means.[47]As a group, Sandstorm is vastly less powerful than Ukraine or other targets, yet their skill and support by allies in the Russian government allow them to compensate for this power differential. The result in Ukraine was a mass power outage that lasted for hours. A larger-scale attack on the United States would surely do more damage. The ubiquity and relative anonymity of cyberspace makes this threat more severe.

Russia is not the only power with cyber capabilities, either, as Admiral Rogers noted in 2014 that China likely has the capability to shut down the U.S. power grid, and that Iran could acquire this capability, too.[48] After the Ukraine attack, the U.S. Department of Energy reported that the U.S. faced imminent dangers from cyberattacks, and that a widespread disruption of electric service could undermine U.S. lifeline networks, critical defense infrastructure, and a significant portion of the economy, in addition to endangering the health and safety of millions of Americans.[49] The complexity of a cyberattack on this scale makes it doubtful that current terrorist networks could plan and execute an attack on the power grid. However, as the Ukraine attack shows, they are technologically possible. According to a simulation by the University of Cambridge's Centre for Risk Studies, an extreme blackout caused by a team of highly skilled personnel with many months of planning and operational implementation could feasibly take control of 50 generators in the U.S. power grid and cause them to overload.[50] The result of this scenario would plunge 15 states into darkness and leave up to 93 million without power, while disrupting water supplies and transport networks.[51] The shift to online work and education during the pandemic also provides more opportunities for criminal groups to execute cyberattacks, which exacerbates the need for increased cybersecurity measures.

Threat of Opportunist Terrorist Organizations

Thus far, this paper has addressed potential vulnerabilities in the U.S. due to the havoc wrought by the global pandemic. Namely, the weakened and uncertain economy, political polarization and social unrest, and vulnerable cyber infrastructure have coalesced into a nexus of crises and opportunity for motivated threat groups. The next portion of this paper explores why such groups, namely terrorist organizations, threaten the U.S. now, amid a global health crisis, and how they could be deterred. For the sake of this paper, terrorism is broadly defined as a method used by insurgents to seize power from an existing government, manifesting in acts of

socially unacceptable violence meant to create a psychological effect on certain groups.[52] This paper also considers domestic, foreign, and even cyber terrorist groups in order to paint in broad strokes the threat of terrorism in and against the U.S. during this global health crisis.

Social science research tends to support the claim that terrorists and their respective organizations consist of rational actors.[53] That is to say, terrorists aim to maximize their utility by weighing the costs and benefits of a certain action when given information and choices.[54] Violence against a certain population or a symbolic representation of such is thus a strategy that the group collectively selects as a course of action that maximizes benefits over costs.[55] Terrorist organizations are also heavily influenced by recent changes in motives and opportunities.[56] This is because terrorists are impatient for action and highly sensitive to time constraints, which may be rooted in their calculations of ends and means.[57] When vulnerabilities in government manifest, terrorist organizations may rationally decide to take the chance to compensate for its inferiority and execute an attack.[58] In other words, when the balance of power between the terrorist organization and the regime they oppose is disrupted in the favor of the former, it is in the best interest of the organization to capitalize.

Martha Crenshaw describes two forms of vulnerabilities that make an established regime, such as the United States, vulnerable to challenge. The first vulnerability is when the regime's ability to respond effectively, efficiently repress dissent, or protect its own citizens is weakened.[59] In 1983, for example, a terrorist attack on U.S. Marines barracks in Beirut killed over 240 U.S. servicemen, an attack in which lax security in and around the barracks played a crucial role in leaving American troops vulnerable to attack.[60] Currently, the U.S. has its hands full in dealing with the virus and distributing vaccines. With the world's largest number of COVID-19 cases and deaths, the U.S. may appear to be unable to protect its citizens. A preliminary assessment on the impact of COVID-19 on Salafi-jihadist and far-right extremists has shown that members of such groups have greeted the global health crisis with enthusiasm because it has crippled the U.S. and other western nations, perhaps vindicating their respective ideologies and objectives.[61] An ISIS editorial article in the al-Naba' Magzine included a call to action for Muslims to capitalize on the paralysis of western governments, stating that, "The Mujahedeen should show no mercy towards the suffering West."[62] The pandemic diverts resources and assets from security and counterterrorism duties, which further exacerbates the vulnerability to an opportunist attack. As of March 2021, the Department of Defense identified more than 6,000 active-duty service members to support vaccination centers.[63] The economic and financial crises may also inhibit the United States' ability to defend itself from external threats, as these matters may divert the attention of policymakers from vital national security threats.

The second type of vulnerability that makes the regime an attractive target for terrorist organizations manifests when the regime makes itself morally or politically vulnerable by increasing the likelihood that terrorists will gain popular support.[64] If a government is overly repressive, they will provoke backlash and lose public support, support which then could be diverted to insurgent or extremist groups. The current sociopolitical climate in the U.S., one driven by polarization and partisanship, could present such vulnerability and lend legitimacy to anti-government extremist groups. The contested election of President Joe Biden over the incumbent Donald Trump was a breeding ground for conspiracy theories and charges of election fraud. Former President Trump was a major source of misinformation regarding the election and tweeted over 200 inaccurate messages about unsubstantiated claims of voter fraud, with a particular emphasis on mail-in ballots.[65] Effectively, only 61 percent of Republicans believed Biden rightfully won the election, according to a Northeastern University poll taken one month after the election.[66] Political division and uncertainty came to a head in the January 6 Capitol riot, in which hundreds of pro-Trump and far-right domestic extremist protesters gathered and eventually infiltrated the Capitol to contest Biden's Electoral College victory.[67] This event sparked international condemnation by world leaders from the UK, Germany, France, and even Russia, as the U.S. took a big hit to its international legitimacy and democracy.[68]

The backlash from this riot may further motivate foreign terrorist organizations to attack while the U.S. is vulnerable or as its legitimacy is in turmoil. However, the threat of domestic terrorism may be more severe. Far-right extremist groups are likely to be emboldened by the Capitol riot, as the ODNI report suggested.[69] If the U.S. response to these groups is viewed as too harsh by the groups themselves and their supporters, they may be encouraged to increase the scale of their attacks in retaliation. These extremists may do so with the perception that their public support is broad, and there is some evidence to support this. For instance, 58 percent of Trump voters said they viewed the January 6 events as "mostly an antifa-inspired attack that only involved a few Trump supporters."[70] There is no evidence that any anti-fascist movement was present at the Capitol, yet the perception that leftist provocateurs continue to pervade right-wing media.[71] To be fair, most Americans do believe it is important to prosecute people who breached the Capitol on January 6; however, this is also a partisan point, with less Republicans deeming prosecution of these criminals as important.[72] The fact is that America is a deeply divided country, and potential areas for unity like the pandemic and domestic extremist attack have only exacerbated the divide. This could potentially make the U.S. look morally weak or illegitimate from the perspective of foreign terrorist groups, but also illegitimate by millions of Americans who feel the current political regime is fraudulent. This may broaden support for anti-government attacks and thus is a significant vulnerability.

Deterring Terrorism

This paper has so far laid out sources of vulnerability that the U.S. currently faces either as a direct result, or byproduct of, the pandemic. The threats posed from opportunity-seeking terrorist organizations, foreign and domestic, are real and must not be overlooked, despite the many other pressing matters the government faces. How, then, should the government go about deterring these threats? Deterrence can first be conceptualized as "a strategic interaction in which an actor prevents an adversary from taking an action that the adversary otherwise would have taken by convincing the adversary that the cost of taking that action will outweigh any potential gains."[73] In other words, an actor must persuade the adversary that a certain action will not produce the expected benefits of said action, and that the action should not be taken. Broadly, there are two types of deterrence strategy with terrorism: deterrence-by-retaliation and deterrence-by- denial.

Deterrence-by-retaliation strategies seek to deter terrorists by threatening to impose unacceptable costs on an adversary if they take a particular course of action.[74] For example, if a jihadist group makes threats against the U.S. homeland about an imminent attack, the U.S. could try to deter the attack by imposing a high cost to the group. The costs could be in the form of sanctions or a coordinated military response. The cost imposed must be great enough to deter the terrorist from pursuing their attack. Deterrence-by-denial strategies, on the other hand, threaten to deny an adversary the benefits of a particular course of action.[75] An actor must convince the adversary that they will not succeed or reap benefits from an action. In their analysis of terrorist deterrence strategies, Kroenig and Pavel also differentiate between direct and indirect approaches to deterrence. Direct approaches aim to deter adversaries by threatening to retaliate against the adversary, whereas indirect response strategies are those that deter by threatening to retaliate against something the terrorists value, like their assets or communities.[76] These different deterrent strategies are featured in **Table 1**, borrowing from examples from Kroenig and Pavel.[77]

TABLE 1

	Cost Imposition	Denial of Benefits
Direct Approach	Threaten to retaliate against terrorists	Threaten to deny the terrorists a tactical success
Indirect Approach	Threaten to respond against terrorist's assets/things they value	Threaten to deny the terrorists strategic success (keeping forces in their community, for example)

Frey also provides a thorough overview of terrorism response and deterrence strategies that include and extend those discussed by Kroenig and Pavel.[78] Frey distinguishes soft and hard responses, the former aiming to address the root causes of terrorism while the latter imposes immediate and strong retribution.[79] Conciliatory responses may consist of accommodating the demands of terrorists, but also includes addressing the grievances of the terrorists without dealing with them directly.[80] Deterrent responses consist of applying criminal justice, by means of prosecution and ultimately conviction.[81] Frey also differentiates between short- and long-run responses to terrorism, where the short run deals with immediate problems created by terrorists, while the long run is directed at long-term reform and prevention.[82] Finally, Frey identifies reactive and proactive responses, the former, of course, referring to actions taken in response to a terrorist incident and the latter consisting of steps taken to identify and prevent terrorist activity before it occurs.[83]

Potential Solutions to Shore Up Vulnerabilities

Now that the main facets of terrorist deterrence have been broadly explained, this paper will present a strategy that borrows a little from each in hopes of creating a holistic terrorist deterrent strategy that catered to the threats to the U.S., both internal and external, that have been magnified by the global health crisis. This strategy is indirect in the sense that the response does not initiate contact nor threaten foreign or domestic terrorist organizations. Rather, it aims to address and resolve the vulnerabilities created by the pandemic, lest they be exploited by opportunist threat groups. The strategy is applicable in both the long and short term and is proactive instead of reactive. By shoring up the vulnerabilities in the American economy, political, social, and cyber arenas, opportunist terrorist organizations will lack exploitable opportunities to strike the U.S. with its back turned. The first vulnerability that must be addressed is the economy, which has been in turmoil because of the social distancing measures, business closures, and job losses provoked by the pandemic. Economic turmoil begets uncertainty, which could provide motivate criminal networks to take drastic steps to rectify their economic deprivation. Furthermore, the United States' back may be turned to these threats as it works to stimulate the economy, leaving it vulnerable to threats, internal and external. This paper argues that if the U.S. can build a resilient post-pandemic economy, it will effectively minimize these vulnerabilities. The matter becomes, then, how does the U.S. minimize the vulnerability to the economy and build a resilient economy, one that can withhold the tensions created by global health crises? This paper explores possible policy actions in pursuit of this question.

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) interviewed economic policy experts on how to build a resilient

post-COVID economy. The experts reached a consensus on a set of broad themes. The U.S. is more economically developed than most countries in the Asia and Pacific region, but the input of ESCAP is relevant because the pandemic has shown that even the mighty U.S. is susceptible to pandemic-induced economic fallout. The commission emphasizes that strong and sustained macroeconomic policy is essential to shorten the post-pandemic recession and minimize long-term scars to the economy.[84] In other words, the U.S. should not be afraid to sustain relief and stimulus packages for the foreseeable future, as this could help prevent an unequal recovery. The pandemic has disproportionately impacted the economically vulnerable, such as the less educated and low earning. Of the U.S. jobs deemed "vulnerable" to pay cuts and layoffs, 86 percent are held by those earning under $40,000 a year, compared to one percent of jobs held by earners of over $70,000.[85] Additionally, U.S. billionaires also expanded their wealth by 20 percent between March and June 2020, while millions of Americans and small business owners continue to grapple with lost wages and unemployment.[83] Put simply, the economic stimulus must not forget the most vulnerable. The U.S. cannot sacrifice Americans jobs and lives for a growth in GDP.

ESCAP also urges governments to explore unconventional financing mechanisms like catastrophe risk insurance and multilateral financial safety nets to enhance the fiscal buffer for future shocks.[87] The commission also emphasizes the need for governments to make economies more inclusive and environmentally sustainable by focusing on strengthening health and social protection systems and closing the digital divide, which has been deepened since the pandemic forced jobs and education fully online.[88] U.S. policymakers should also diversify the economy in ways that make them better at withstanding market volatility and invest in innovation. This means building and strengthening research and development, entrepreneurship, and commercialization from the local to national levels.[89] Leaders should commit to long-term investments in the American people, regardless of race, ethnicity, gender, or wealth, as equity-enhancing measures can boost economic growth in the long run. According to one estimate, achieving gender equality could add up to $4 trillion to the U.S. economy by 2025.[90] In short, the U.S. must invest in the American people, in both the short and long term. These investments are key for resilient economies and resilient countries. While investments and economic innovations of this scale are daunting, the benefits surely outweigh the costs. With a more resilient, human-centered economy, the vulnerabilities in the economy will be greatly minimized.

The next vulnerability that must be shored up is social and political polarization, which has been a significant source of conflict before and during the pandemic. Polarization and a sense of distrust in the "other" or the government at large is a dangerous threat to the American political system and way of life, as evidenced by the Capitol Hill storming. If the U.S. can work to increase unity, understanding, and

empathy, then the threat of domestic extremists who oppose the current political system will be minimized. There is no quick fix to reverse the deep animus Americans have towards members of the opposing political party, but small steps combined with bold ideas can set the U.S. on the right path. As of 2019, 77 percent of Americans believed that their differences with the opposing party are not so great that they cannot come together.[99] While it may be more challenging for Americans to come together after this divisive and tumultuous year, it is far from impossible with constructive intergroup contact and responsive government.

Americans on each side of the political spectrum take cues from party leaders and media influencers, which heavily influence voting behavior and other political choices.[92] When these influencers and political elites speak on political, social, or cultural issues, their followers listen, even if the information they provide is not always an accurate representation of reality. With the proliferation of social media, these messages are available at all hours of the day and are not vetted thoroughly, which exacerbates the divide. This has been especially apparent during the pandemic, with conspiracy theories about the virus, vaccines, and the election spreading across the country instantaneously. This fuels partisanship and outgroup hostility. Constructive intergroup interactions and contact can help minimize this hostility by bringing people from opposing political beliefs together. Intergroup contact is beneficial because it allows people to learn about members of the social outgroup and reduces anxiety about intergroup interactions, as well as increase empathy with members of the outgroup.[93] Intergroup contact must be facilitated carefully to prevent further polarization and intergroup hostility. One example of a model of intergroup contact is "Citizen Assemblies," in which citizens are brought together to deliberate over pertinent social and political issues.[94] If the U.S. gives its people a forum for constructive deliberation and understanding, the country could develop a stronger sense of unity and empathy. And because Americans take cues from their party leaders, members of Congress and the Executive must lead by example. Senator Mitt Romney has reiterated this very point when asked about the polarization of America and has suggested the reinstitution of weekly meetings for Republican and Democratic senators.[95] Media at all levels must take fact-checking seriously in order to present the truth on matters of national importance, such as a pandemic. Misinformation in all levels of media can foment hate and deepen division, and those that stoke these flames should be held accountable. Those who do not acquiesce to intergroup contact and unity, namely domestic violent extremists, should be prosecuted to the extent that they commit a crime, such as those committed at the Capitol. However, the U.S. should welcome regretters, those who once participated in domestic extremist groups, and offer support if they renounce their activities and reintegrate them into society.[96] A policy of reintegration embodies the unity and empathy the country must practice, as well provides the regretters a sense of belonging and acceptance that may have driven them to

extremism in the first place.

At the individual level, there are many simple practices Americans could adopt to shore up their defense against opportunist cybercriminal networks. For starters, they should back up important files and store them independently from their system. Individuals should regularly check their software and systems and install the latest anti-virus software. They must be vigilant, check and update their privacy settings, and update passwords and ensure that they are strong.[97] At the macro level, the U.S. should consider investing in microgrids to combat the threat of a cyberattack on the U.S. power grid. Microgrids are decentralized, local energy grids that can disconnect from the traditional grid and can thus operate autonomously.[98] "Campus style" microgrids are currently used at military installations, hospitals, colleges, data centers, and other private and public properties that highly value uninterrupted power supplies.[99] Microgrids have proven to be lifesaving during severe storms like Superstorm Sandy in 2012. Millions of residential and commercial customers lost power when Sandy hit, and many critical facilities like water treatment centers, police stations, and hospitals had to rely on standby generators or were completely shut down. One hospital was disconnected from the main grid for two weeks, yet it remained operational with a microgrid.[100] College campuses in the area also used microgrids throughout the duration of the storm and subsequent recovery process.[101] Despite these successes, microgrids only provide less than .2 percent of U.S. electricity, mainly in Alaska, California, New York, Texas, Maryland, Georgia, and Oklahoma.[102] This is mostly due to technical, economic, and regulatory barriers. To begin with, microgrids and similar distributed energy resources are not designed for resiliency, meaning they cannot operate as a standalone power source in cases of an outage. Economically, research and development for microgrids are expensive for residential and commercial use, and the government often must provide tax incentives and funding for such projects. Due to the polarization of renewable energy and climate change-related services, this is a significant struggle. Microgrids still provide a reliable power source in cases of emergency, and the growing cyberthreat should pressure the U.S. government to invest in alterative power sources such as these to maintain resilient cyber and power structures.

Conclusion

The threat of terrorism, either from domestic, foreign, or cyber threats can easily be overlooked in the middle of a global health crisis. Testing and vaccination logistics are complicated matters and demand attention from U.S. leaders, as does the economic fallout from yearlong disruptions in commerce and employment. Government leaders must not sleep on the vulnerabilities revealed by the pandemic, though. Rather, by addressing and working to rectify the flaws and vulnerabilities in the current U.S. government, economy, and society, terrorist groups are effectively deterred by not giving them any opportunities to attack. This strategy may seem

idealistic, too broad, or too unrelated to the terrorism, and to a degree this is true. Large economic policy changes, human-centered investments, sociopolitical unity and bipartisanship, and beefed-up cyber and energy sectors are daunting tasks that take a considerable amount of time and money. Moreover, terrorism is a multifaceted issue with differing methods, objectives, ideologies, and motivations, meaning an effective deterrent strategy must be comparatively multifaceted and complex to effectively counter the threat. However, many big problems require bold solutions, and there is hardly any problem bigger than the threat of opportunity-seeking terrorist groups combined with the threats and vulnerabilities imposed by a pandemic. Resiliency is at the heart of this unique, albeit indirect approach to deterring and preventing terrorism in the United States. By focusing on creating and maintaining policies and institutions at all levels of government and the economy, vulnerabilities will be minimized, and so too the threats posed by opportunist terror groups who threaten the United States.

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Notes

1. The New York Times. "Coronavirus in the U.S.: Latest Map and Case Count." The New York Times. The New York Times, March 3, 2020. https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html?action=click&module=Top+Stories&pgtype= Homepage.

2. Ibid.

3. Merriam-Webster, "Vulnerable." Merriam-Webster. Merriam-Webster. Accessed March 20, 2021.https://www.merriam-webster.com/dictionary/vulnerable.

4. Ibid.

5. Congressional Budget Office, "Interim Economic Projections for 2020 and 2021." Congressional Budget Office, 2020. https://www.cbo.gov/publication/56368#:~:text=The%20unemploymaboent%20rate%20is%20projected, 2019%2C%20before%20the%20pandemic%20began.

6. Kochhar, Rakesh, "Unemployment Rose Higher in Three Months of COVID-19 than It Did in Two Years of the Great Recession." Pew Research Center. Pew Research Center, August 26, 2020. https://www.pewresearch.org/fact-tank/2020/06/11/unemployment-rose-higher-in-three-months-of-covid-19-than-it-did-in-two-years-of-the-great-recession/.

7. Ibid.

8. Congressional Budget Office, "Interim Economic Projections for 2020 and 2021."

9. Congressional Budget Office, "Interim Economic Projections for 2020 and 2021."

10. Congressional Budget Office, "Additional Information About the Economic Outlook: 2021 to 2031," Congressional Budget Office, 2021. https://www.cbo.gov/publication/57014#_idTextAnchor051.

11. Congressional Budget Office, "Additional Information About the Economic Outlook: 2021 to 2031."

12. Ibid.

13. Ibid.

14. Ibid.

15. Ibid.

16. Nurunnabi, Mohammad and Asma Sghaier, 2018, "Socioeconomic Determinants of Terrorism," DOMES: Digest of Middle East Studies 27 (2): 278–302. doi:10.1111/dome.12139.

17. Nurunnabi, Mohammad and Asma Sghaier, "Socioeconomic Determinants of Terrorism."

18. Staub, Ervin. 2007, "Preventing Violence and Terrorism and Promoting Positive Relations Between Dutch and Muslim Communities in Amsterdam." Peace & Conflict 13 (3): 333–60. doi:10.1080/10781910701471397.

19. Nurunnabi, Mohammad and Asma Sghaier, "Socioeconomic Determinants of Terrorism."

20. Piazza, James A. 2011, "Poverty, Minority Economic Discrimination, and Domestic Terrorism," Journal of Peace Research 48 (3): 339–53. doi:10.1177/0022343310397404.

21. Piazza, James A, "Poverty, Minority Economic Discrimination, and Domestic Terrorism."

22. Estrada, Mario Arturo Ruiz, Donghyun Park, Jung Suk Kim, and Alam Khan. 2015. "The Economic Impact of Terrorism: A New Model and Its Application to Pakistan." Journal of Policy Modeling 37 (6): 1065–80. doi:10.1016/j.jpolmod.2015.08.004.

23. Ismail, A., & Amjad, S. (2014). Determinants of terrorism in Pakistan: an empirical investigation. Economic Modelling, 37, 320–331.

24. McCarthy, Ti,. "Disunited States of America: Responses to Coronavirus Shaped by Hyper-Partisan Politics," The Guardian, Guardian News and Media, March 29, 2020. https://www.theguardian.com/us-news/2020/mar/29/america-states-coronavirus-red-blue-different-approaches

25. Allcott, Hunt, Levi Boxell, Jacob Conway, Matthew Gentzkow, Michael Thaler, and David Yang,"Polarization and public health: Partisan differences in social distancing during the coronavirus pandemic," Journal of Public Economics 191 (2020): 104254.

26. Ibid.

27. Wilber, Quentin, "FBI Director Says Capitol Riot Was 'Domestic Terrorism'," Los Angeles Times. Los Angeles Times, March 20, 2021. https://www.latimes.com/politics/story/2021-03-02/fbi-wray-testify-congress-capitol-siege.

28. Office of the Director of National Intelligence.*Domestic Violent Extremism Poses Heightened Threat in 2021*.Office of the Director of National Intelligence, 2021.https://www.dni.gov/files/ODNI/documents/assessments/UnclassSummaryofDVEAssessment-17MAR21.pdf Accessed 20 March 2021.

29. Pew Research Center, "Partisan Antipathy: More Intense, More Personal," Pew Research Center - U.S. Politics & Policy, Pew Research Center, August 17, 2020. https://www.pewresearch.org/politics/2019/10/10/partisan-antipathy-more-intense-more-personal/?utm_source=link_newsv9&utm_campaign=item_268982&utm_medium=copy.

30. Ibid.

31. INTERPOL, "COVID-19 Cyberthreats," INTERPOL, April 2, 2020. https://www.interpol.int/en/Crimes/Cybercrime/COVID-19-cyberthreats

32. Ibid.

33. Ibid.

34. Ibid.

35. Ikeda, Scott, "Healthcare Cyber Attacks Rise by 55%, Over 26 Million in the U.S. Impacted," CPO Magazine, February 26, 2021. https://www.cpomagazine.com/cyber-security/healthcare-cyber-attacks-rise-by-55-over-26-million-in-the-u-s-impacted/#:~:text=The%20total%20count%20of%20US,%2C%20an%20increase%20of%2055.1%25.&text=However%2C%20in%20terms%20of%20impact,to%20these%20healthcare%20cyber%20attacks.

36. INTERPOL, "COVID-19 Cyberthreats."

37. "Cybersecurity." Department of Homeland Security, March 1, 2021 .https://www.dhs.gov/topic/cybersecurity.

38. Hansler, Jennifer, Pamela Brown, and Devan Cole, "Russian Disinformation Campaign Working to Undermine Confidence in Covid-19 Vaccines Used in US," CNN, Cable News Network, March 8, 2021 .https://www.cnn.com/2021/03/07/politics/russian-disinformation-pfizer-vaccines/index.html.

39. Knake, Robert K., Report, Council on Foreign Relations, 2017. Accessed 23 March 2021.http://www.jstor.org/stable/resrep05652.

40. Sullivan, Julia E., and Dmitriy Kamensky. 2017, "How Cyber-Attacks in Ukraine Show the Vulnerability of the U.S. Power Grid," Electricity Journal 30 (3): 30–35. doi:10.1016/j.tej.2017.02.006.

41. Knake, Robert K., Report, Council on Foreign Relations.

42. Sullivan, Julia E., and Dmitriy Kamensky, "How Cyber-Attacks in Ukraine Show the Vulnerability of the U.S. Power Grid."

43. Hultquist, John, "Sandworm Team and the Ukrainian Power Authority Attacks," FireEye, January 8, 2016.https://www.fireeye.com/blog/threat-research/2016/01/ukraine-and-sandworm-team.html.

44. Ibid.

45. Sullivan, Julia E., and Dmitriy Kamensky, "How Cyber-Attacks in Ukraine Show the Vulnerability of the U.S. Power Grid."

46. Tilly, Charles, 2003, "The Politics of Collective Violence" [VitalSource Bookshelf], Retrieved fromhttps://bookshelf.vitalsource.com/#/books/9781107485976/

47. Ibid.

48. Knake, Robert K., Report, Council on Foreign Relations

49. Sullivan, Julia E., and Dmitriy Kamensky, "How Cyber-Attacks in Ukraine Show the Vulnerability of the U.S. Power Grid."

50. Ruffle, Simon & Leverett, Eireann & Coburn, Andrew & Copic, Jennifer & Kelly, Scott & Evan, Tamara, 2015, Business Blackout The insurance implications of a cyber attack on the US power grid. 10.13140/RG.2.1.1565.5528.

51. Ibid.

52. Crenshaw, Martha, 2011,*Explaining Terrorism: Causes, Processes and Consequences*London: Routledge.

53. Abrahms, Max, and Karolina Lula, "Why Terrorists Overestimate the Odds of Victory," Perspectives on Terrorism 6, no. 4/5 (2012): 46-62. Accessed 20 March 2021.http://www.jstor.org/stable/26296876.

54. Ibid.

55. Crenshaw, Martha,*Explaining Terrorism: Causes, Processes and Consequences,*112.

56. Waterman, Harvey, "Reasons and Reason: Collective Political Activity in Comparative and Historical Perspective," *World Politics*33, no. 4 (1981): 554-89. Accessed 28 February 2021. doi:10.2307/2010135.

57. Crenshaw, Martha,*Explaining Terrorism: Causes, Processes and Consequences,*115.

58. Ibid.

59. Ibid.

60. Dalesio, Emery P., and Allen G. Breed, "30 Years Later, Survivors Recall Beirut Blast," AP NEWS. Associated Press, October 23, 2013.https://apnews.com/article/lebanon-jacksonville-bombings-civil-wars-terrorist-attacks-e0917018dda942cc8bededе033742c9d.

61. Wither, James K., "The COVID-19 Pandemic: A Preliminary Assessment of the Impact on Terrorism in Western States," George C. Marshall European Center For Security Studies, April 2020.https://www.marshallcenter.org/en/publications/occasional-papers/covid-19-pandemic-preliminary-assessment-impact-terrorism-western-states.

62. Norlen, Tova C,"The Impact of COVID-19 on Salafi-Jihadi Terrorism." Connections (18121098) 19 (2): 11–24, 2020, doi:10.11610/Connections.19.2.01.

63. Lopez, C. Todd, "DOD Identifies More Troops to Help Administer COVID-19 Vaccine," U.S. DEPARTMENT OF DEFENSE, March 6, 2021.https://www.defense.gov/Explore/News/Article/Article/2526831/dod-identifies-more-troops-to-help-administer-covid-19-vaccine/.

64. Crenshaw, Martha,*Explaining Terrorism: Causes, Processes and Consequences,*115.

65. Spangler, Todd, "Twitter Has Flagged 200 of Trump's Posts as 'Disputed' or Misleading Since Election Day. Does It Make a Difference?" Variety, November 27, 2020.https://variety.com/2020/digital/news/twitter-trump-200-disputed-misleading-claims-election-1234841137/.

66. Ramjug, Peter, "Many Republicans Don't Believe the Election Results, a New Survey Says," News Northeastern Many Republicans dont believe the election results a new survey says Comments, December 11, 2020.https://news.northeastern.edu/2020/12/11/who-won-the-2020-presidential-election-joe-biden-or-donald-trump-depends-whom-you-ask/.

67. Anderson, Meg, "Antifa Didn't Storm The Capitol. Just Ask The Rioters," NPR, March 2, 2021.https://www.npr.org/2021/03/02/972564176/antifa-didnt-storm-the-capitol-just-ask-the-rioters.

68. BBC News, "US Capitol Riots: World Leaders React to 'Horrifying' Scenes in Washington," BBC News, BBC, January 7, 2021.https://www.bbc.com/news/world-us-canada-55568613.

69. Office of the Director of National Intelligence,*Domestic Violent Extremism Poses Heightened Threat in 2021.*

70. Anderson, Meg, “Antifa Didn't Storm The Capitol. Just Ask The Rioters,”

71. Ibid.

72. “Most Americans Say Prosecuting Capitol Rioters Is 'Very Important'," Pew Research Center - U.S. Politics & Policy, Pew Research Center, March 18, 2021.https://www.pewresearch.org/politics/2021/03/18/large-majority-of-the-public-views-prosecution-of-capitol-rioters-as-very-important/.

73. Kroenig, Matthew, and Barry Pavel, “How to Deter Terrorism,” Washington Quarterly 35 (2): 21–36, 2021, doi:10.1080/0163660X.2012.665339.

74. Ibid.

75. Ibid.

76. Ibid.

77. Ibid.

78. Frey, Bruno S., "Countering Terrorism: Deterrence vs More Effective Alternatives," *Open Economics*1, no. 1, 2018: 30-35.

79. Ibid.

80. Ibid.

81. Ibid.

82. Ibid.

83. Ibid.

84. Saxena, Sweta, “Building a Post-COVID-19 Resilient Economy,” United Nations ESCAP, November 27, 2020. https://www.unescap.org/blog/building-post-covid-19-resilient-economy.

85. Cheng , Wan-Lae, Andre Dua, Zoe Jacobs, Mike Kerlin, Jonathan Law, Ben Safran, Jorg Schubert, Chun Ying Wang, Qi Xu, and Ammanuel Zegeye,“Reimagining the Postpandemic Economic Future,” McKinsey & Company. McKinsey & Company, December 4, 2020.https://www.mckinsey.com/industries/public-and-social-sector/our-insights/reimagining-the-postpandemic-economic-future.

86. Ibid.

87. Saxena, Sweta, “Building a Post-COVID-19 Resilient Economy,”

88. Ibid.

89. Cheng , Wan-Lae, Andre Dua, Zoe Jacobs, Mike Kerlin, Jonathan Law, Ben Safran, Jorg Schubert, Chun Ying Wang, Qi Xu, and Ammanuel Zegeye,“Reimagining the Postpandemic Economic Future.”

90. Ellingrud, Kweilin, Anu Madgavkar, James Manyika, Jonathan Woetzel, Vivian Riefberg, Mekala Krishnan, and Mili Seoni, “The Power of Parity: Advancing Women's Equality in the United States,” McKinsey & Company. McKinsey & Company, April 7, 2016.https://www.mckinsey.com/featured-insights/employment-and-growth/the-power-of-parity-advancing-womens-equality-in-the-united-states

91. Hawkins, Stephen, Daniel Yudkin, Míriam Juan-Torres, and Tim Dixon, “Hidden Tribes: A Study of America’s Polarized Landscape,” More in Common, More in Common,

2018.https://hiddentribes.us/media/qfpekz4g/hidden_tribes_report.pdf.

92. Iyengar, Shanto, and Sean J. Westwood, "Fear and Loathing across Party Lines: New Evidence on Group Polarization," American Journal of Political Science 59, no. 3 (2015): 690-707, Accessed 21 March 2021.http://www.jstor.org/stable/24583091.

93. Hewstone, M., & Swart, H., Fifty-odd years of inter-group contact: From hypothesis to integrated theory, British Journal of Social Psychology, 50, 374–386, 2011, doi:10.1111/j.2044-8309.2011. 02047.x

94. de-Wit, Lee, Sander van der Linden, and Cameron Brick, "What Are the Solutions to Political Polarization?" Greater Good, July 2, 2019.https://greatergood.berkeley.edu/article/item/what_are_the_solutions_to_political_polarization.

[95. "Idea: Bring Back Weekly Bipartisan Senate Meetings," POLITICO. POLITICO, 2019.https://www.politico.com/interactives/2019/how-to-fix-politics-in-america/polarization/bring-back-weekly-bipartisan-senate-meetings/.

96. Frey, Bruno S., "Countering Terrorism: Deterrence vs More Effective Alternatives."

97. "COVID-19 Cyberthreats." INTERPOL. INTERPOL, April 2, 2020.https://www.interpol.int/en/Crimes/Cybercrime/COVID-19-cyberthreats.

98. "How Microgrids Work," Energy.gov, June 17, 2014.https://www.energy.gov/articles/how-microgrids-work.

99. Sullivan, Julia E., and Dmitriy Kamensky, "How Cyber-Attacks in Ukraine Show the Vulnerability of the U.S. Power Grid."

100. Ibid.

101. Ibid.

102. "Microgrids," Center for Climate and Energy Solutions, October 25, 2017. https://www.c2es.org/content/microgrids/#:~:text=Microgrids%20provide%20less%20than%200.2,York%2C%20Oklahoma%2C%20and%20Texas.

Book Review

Aaron F. Brantly, *The Cyber Deterrence Problem* (Rowman & Littlefield International, Ltd., 2020), 202 pp.

Yen Huynh

The usage of cyberwarfare has become increasingly prevalent in the global landscape, but there remains a lack of cohesive strategies and policies surrounding cyber deterrence. Aaron Brantly and a team of scholars specializing in different disciplines team up to develop the outline for a robust deterrence strategy concerning cyberspace. Brantly is an Assistant Professor of Political Science at Virginia Tech. He is also a Senior Research Scientist at the Army Cyber Institute at the United States Military Academy, West Point. In his book, he proposes different approaches that can and should be utilized to enhance deterrence in cyberspace.

The Cyber Deterrence Problem is best suited for scholars and those with at least a basic level of understanding regarding what cyberwarfare is. The arguments and concepts discussed in the book can be difficult to understand otherwise. The book looks to define what cyber deterrence is and develop a robust framework for policymakers to be able to reference the creation of cyber deterrence methods and policies. Cyberspace is the domain of global networks of technology infrastructures, telecommunication networks, and computer processing systems. Cyberwarfare is the use of digital attacks to cause damage or disrupt a country's computer system. The authors argue that the world of cybersecurity is quickly evolving, and states are scrambling to create strategies of prevention and response methods against cyber threats. This is what cyber deterrence centers around. As such, the United States needs to keep up with the adoption of new cyber deterrence policies to match the escalating threat levels. It is here where Brantly and his contributors try to make a splash. They posit that the United States needs to advance the current interest and government involvement in the creation and implementation of cyber deterrence methods.

Cyberspace is an ever-changing world, and though it lies below the nuclear threshold, threats of force are still common. Even so, the credibility of such threats varies, and they are rarely carried out. Unlike in the physical world, where deterrence is aimed at fighting physical targets, deterrence in cyberspace is different. Rather, it is directed against manipulations of elements of cyberspace and those engaging there. It is here that Brantly says the focus needs to shift if the United States is to keep our technological infrastructure safe. To sufficiently understand the threats and the different methods in creating a credible framework, the book utilizes approaches from different relevant fields to create better cyber deterrence strategies. By employing a multidisciplinary approach to the study of cyber deterrence, the book attempts to create a more comprehensive framework of strategies.

Classic deterrence centers on the potential adversary's cost-benefit analysis to see if their actions will elicit a response in the form of force. This is problematic because classic deterrence also sees that the defending states threaten the use of force or power but do not end up using them. Modern formulations of deterrence are mostly grounded on the concept of nuclear weapons and other traditional means of military weaponized interventions. In the cyberspace world, two main types of deterrence are commonly referenced. Deterrence by punishment and deterrence by denial are both intended to manipulate the cost-benefit analysis of an adversary. That is to say that an adversary is likely to change their calculations depending on the type of deterrence that the defending state is most likely to use. Deterrence is not yet well developed in the cyber world and can also be complex to understand and establish. The definitions of the two types of deterrence are defined multiple times, which could be confusing. Instead, it was a good way to remind readers of what deterrence by punishment and denial are.

Generally, deterrence by punishment focuses on the employment of threats to let adversaries know the costs of their unacceptable actions. On the other hand, deterrence by denial relies on the threat of denying the adversary the ability to achieve military and political gains through aggression. Deterrence by denials also attempts to convince attackers that their cyberattack will be more likely to fail than succeed, which makes the cost of trying not worth it. Successful deterrence can only occur when the potential adversary decides against carrying out the cyberattack due to the fear of punishment or the high possibility of failure.

To be successful, cyber deterrence policies should exhibit three critical features. The mechanisms 1) must successfully signal to the adversary the costs, 2) locate any present threats that exist in the cyber domain, and 3) cyber deterrence strategies should avoid utilizing nuclear analogy. As cyberattacks rank as the second-most-cited threat, the United States needs to move the deterrence framework forward. As the authors argue, the three prior mentioned components are essential in creating more secure cyberspace. The United States must clearly state what the punishments will be but also be able to swiftly identify cyber intruders. The book claims that the most difficult aspect is perhaps the need to rewire the brain to think about cyberwarfare in different terms as opposed to the kinetic or nuclear world. Even so, are the differences so vast that states must rethink their whole deterrence framework? Brantly does not provide evidence for this. It would be extremely helpful for readers to understand why he believes this to be an important consideration, especially when some of his readers may very well be involved in the decision-making of cyber deterrence policies and strategies.

Brantly and his co-authors try to drive the idea about the difference in the employment and responses of cyberspace and nuclear usage. The book claims that it is still possible for states to cross domains and utilize military force when responding

to cyberattacks. This is likely to happen if the cyberattack were deemed to pass a threshold of high salience and therefore elicits such a response. This makes it hard to fully understand the line between cyberattacks and military force or nuclear usage. When a cyberattack undermines active military operations or disables critical infrastructures, a cross-domain response will be more likely. This is especially so if the cyberattack threatens a state's homeland security system. In conjunction with cross-domain engagement, this also pushes forth the idea that states will utilize both the means of cyberattacks and military force when they are the aggressor and not just on the defense. The book fails to consider the impact of this.

It should be noted that anyone can involve themselves in cyberspace. There is a learning curve but once past it, the number of potential attackers increases. This refers to both state and non-state actors. As mentioned, multiple times throughout the book, the authors do remind readers that costs for adversaries in cyberspace are commonly lower than in the kinetic realm. The benefits can vastly vary depending on the goal of the attacker. In addition, it must be more challenging for the state being attacked to positively identify the attacker. Many cyberattackers can efficiently avoid detection and even when attacks are identified, finding the perpetrator remains an arduous task.

Due to the level of destruction that nuclear weapons can cause, they are seen as a weapon of last resort. The book claims that, consequently, cyberwarfare engagements are likely to continue as a first-step procedure. Other forms of military technology and interventions will be utilized when states know that a cyberattack is unlikely to accomplish what is needed. As previously mentioned, this assumption is to say that the United States and other governments do not think about employing both cyberattacks and military interventions, either to respond to attacks or when trying to accomplish something. Cyber-retaliation may be the cheaper method but is not always the most effective.

It can be hard to fully gauge the reasons behind a cyberattack. The more a state engages in invasive intelligence via cyberspace, the likelier their actions will be misinterpreted. In trying to read the reasonings behind attacks carried out in cyberspace, there are limits to what can be explained. The costs of cyberattacks and cyberwarfare are generally low. It can prove difficult to create successful overarching deterrence policies. Typically, cyber aggressors will keep trying to probe the system until they can find an entry point and successfully carry out their mission. As such, there are limitations to deterrence. Even though the authors have mentioned this fact, the book persists in claiming that deterrence is a necessary measure. If deterrence has limitations, then other methods should also be applied to increase the cybersecurity measures. Towards the end, the book does incorporate norms as a part of the cyber-deterrence discussion. While it is a worthwhile effort, previous chapters already reference this though not specifically referring to it as cyber norms.

Consequently, the book and co-authors can expand on the limitations of the cyber-deterrence strategies and what other realistic strategies could be included.

The book states that deterrence by punishment is less likely to be effective due to the high levels of uncertainty in identifying the attackers and the assets that are at risk. Clear signaling of costs can help establish the foundation for deterrence by punishment. The issue is that most cyberattacks exist below the threshold that is necessary to trigger punishment, which is why it is the less effective form of deterrence. As such, deterrence by denial should be strongly considered. Brantly and his co-contributors have expanded the platform for deterrence considerations. The methods explained in the book can showcase the importance of having a comprehensive framework on cyber deterrence. The over-arching framework that the book for the argument of cyber deterrence is thorough but not exhaustive. The complex details are laid out in a detailed and easy-to-understand manner once you have a basic understanding of cyberspace, cyberwarfare, and cyber deterrence.

Brantly offers a broad overview of the topic of cyber deterrence. He makes a solid argument as to why it is a necessity. Readers will understand why the United States needs to keep up with the strategic framework on cyber deterrence and what some of the potential approaches towards policy implementation can be. Readers should take note that there are some limitations. As previously mentioned, cyber deterrence is not going to solve all the problems that the United States encounters in cyberspace. Brantly and his fellow contributors do not do much to build on providing other methods that can be used in conjunction with cyber deterrence to strengthen the country's cybersecurity measures. Even so, *The Cyber Deterrence Problem* will help readers understand the importance of cyber deterrence and what some of the basic approaches are.

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