Stanton Nuclear Security Fellows Seminar

PANEL 3: Delivery System Issues

1. Debak Das, CISAC

Delivering the Bomb: Nuclear Forces, Ambiguity, and the Non-proliferation Order

My project examines why the non-proliferation regime instead of constraining the spread of the means of nuclear delivery, enables it. One of the most important aspects of building a nuclear weapon is acquiring the capacity to deliver the bomb. This is what determines nuclear doctrines, strategies, and the credibility and effectiveness of nuclear deterrence postures. However, studies of nuclear proliferation have largely ignored the question of nuclear delivery. I address this gap and ask two main questions. First, how do states build their means of nuclear delivery? This is an undertheorized topic in the study of international security and gives us insight into what happens after a state develops its nuclear weapons. Second, at the heart of this study lies an empirical puzzle. Why do the means of nuclear delivery proliferate despite the obvious constraints?.[1] We would expect that the non-proliferation order, consisting of a number of multilateral treaties, as well as aggressive counterproliferation efforts by individual states like the United States, would constrain the sale and transfer of technology related to nuclear weapons delivery. However, contrary to this expectation, the historical record demonstrates that this has not been the case. If anything, the non-proliferation regime and its constituents have been *enablers* of proliferation related to the means of nuclear delivery.

I argue that there exists a Zone of Ambiguity in the global nuclear non-proliferation regime that helps the proliferation of the means of nuclear delivery. This Zone consists of two elements – ambiguous definitions and multipurpose technology – that have produced normative and legal ambiguity surrounding nuclear delivery mechanisms. From the recipient's viewpoint, the Zone helps states justify the acquisition of the means of nuclear delivery due to the ambiguous nature of the technology involved, i.e. they can emphasize the non-nuclear uses of the desired system. For example, a state could purchase an F-16 fighter aircraft to augment its conventional military

[1] The global non-proliferation regime in this study refers to the larger ecosystem of laws and treaties that, along with the NPT, seek to stop the spread of nuclear weapons. See, Grégoire Mallard, *Fallout: Nuclear Diplomacy in an Age of Global Fracture* (Chicago: University of Chicago Press, 2014), 7.

capability and modify it for nuclear delivery afterwards.[2] On the other hand, from the seller's viewpoint, the Zone of Ambiguity helps supplier states rationalize the sale of the means of nuclear delivery. The legal and normative ambiguity surrounding what constitutes a 'nuclear weapon' and whether delivery vehicles are a part of it or not allows supplier states to focus on their national interests – economic or geopolitical – over broader non-proliferation concerns.

To demonstrate the argument, I use two case studies related to India's nuclear force development: the transfer of space technology from France to India in the mid-1970s that led to the latter's first Intermediate Range Ballistic Missile (IRBM) *Agni*; and the United Kingdom's sale of the nuclear-capable Jaguar aircraft to India in 1978. I use an empirical strategy that combines historical archival data with elite interviews. Using newly declassified archival evidence from India, the United Kingdom, France, and the United States, I show that – to the western suppliers – the norm of non-proliferation came second to the economic and geopolitical interests that proliferating the means of nuclear delivery to India represented. Crucially, contrary to the conventional wisdom, I also show that India's acquisition of the means of nuclear delivery began as early as the 1970s, especially after the 1974 test, and continued through the decade.

My argument makes several contributions to the study of nuclear proliferation. First, studies of nuclear proliferation have largely ignored the question of nuclear delivery, despite the fact that acquiring the capacity to deliver the bomb is a crucial aspect of building a nuclear weapon. I address this problem by advancing a new framework to understand how, despite a comprehensive non-proliferation regime, the proliferation of these weapons systems still takes place. This is particularly important from both an academic and policy standpoint given the recent crises of nuclear delivery vehicles proliferation by China, Iran, and North Korea. Second, in identifying the proliferation of nuclear delivery mechanisms via the Zone of Ambiguity, I challenge the narrative of success of the global nuclear non-proliferation regime.[3] While this regime might have been able to restrict the number of states building nuclear bombs, when it comes to the means of nuclear delivery, it has not only failed to control their spread, but actively enabled it.[4] This is significant because if a country manages to build a bomb there is no more

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[2] As in the case of Pakistan. See, John R. Harvey, "Regional Ballistic Missiles and Advanced Strike Aircraft: Comparing Military Effectiveness," *International Security* 17, no. 2 (1992): 41–83; Hans M. Kristensen, Robert S. Norris, and Julia Diamond, "Pakistani Nuclear Forces, 2018," *Bulletin of the Atomic Scientists* 74, no. 5 (September 3, 2018): 348–58.

[3] Nicholas L. Miller, "The Secret Success of Nonproliferation Sanctions," *International Organization* 68, no. 4 (2014): 913–44; Jeffrey W. Taliaferro, *Defending Frenemies: Alliances, Politics, and Nuclear Nonproliferation in US Foreign Policy* (Oxford, New York: Oxford University Press, 2019); Rupal N. Mehta, *Delaying Doomsday: The Politics of Nuclear Reversal*, Bridging the Gap (New York, NY: Oxford University Press, 2020).

[4] "Enabling" here refers to the creation of a permissive environment for the acquisition of technology related to nuclear delivery. This could occur directly by transferring the means of nuclear delivery to a state or indirectly, by allowing a state to access technology related to the development of the means of nuclear delivery. The indirect transfer of technology includes blueprints, resources, goods, services, and other practical support related to the acquisition of technology to build the means of nuclear delivery. George A. Lopez, "Dealing with 'Enablers' in Mass Atrocities: A New Human

institutional constraint for it to be able to project this power. Third, the rich historical material in this article exposes the crucial role played by international agents in the development of the Indian nuclear forces. This has been missed by the domestic narratives on Indian nuclear history that tend to focus on the indigenous nature of the state's nuclear forces. The empirical study also provides a roadmap for how future proliferation of the means of nuclear delivery might take place.

I would be most interested in feedback on the plausibility of the framework, and other cases that the argument can be generalized to.

Rights Concept Takes Shape," *Carnegie Ethics Online Monthly Column*, June 26, 2012, https://www.carnegiecouncil.org/publications/ethics_online/0070.

2. Laura Grego, MIT NSE

US Intercontinental Ballistic Missiles—Surplus to Needs?

The policy problem

The United States is embarking on an expensive and ambitious modernization of its nuclear arsenal, providing an opportunity to reappraise the desirability of maintaining the nuclear triad of bombers, land-based, and sea-based intercontinental ballistic missiles (ICBMs). The plan to build a new land-based intercontinental ballistic missile to replace the Minuteman III missiles, will cost an estimated $110 billion to acquire and $264 billion over its lifetime.

Scholars have made strong arguments for eliminating the ICBM fleet entirely and relying instead on the submarine-based missiles and bombers to provide the United States a nuclear deterrent capability for as long as such a deterrent is believed to be necessary. Bombers can be used to signal a change in alert level by moving them around, and are more flexible since they can be recalled, unlike missiles. Investments in stealthy operation and command and control of U.S. nuclear-armed submarines have rendered them virtually invulnerable to enemy attack for the foreseeable future, while ICBMs must be on high alert to be survivable, requiring the United States assume a riskier nuclear posture than it otherwise would. To keep ICBMs safe from attack, a system must be set up that allows for a launch decision to be made under a compressed timeline, leading to increased risk that the ICBMs would be launched in reaction to a false warning or other mistake. This is particularly concerning in view of the increasing sophistication of cyber attacks, which may potentially target nuclear command and control. Additionally, for US land-based ICBMs to directly target China or North Korea, they must fly over Russia, limiting their suitability for any scenario not involving Russia.

Extending the lifetime of the existing Minuteman III might save a great deal of money while also providing more time to consider the questions about whether the risks and economic costs that land-based missiles incur are balanced with their benefits. However, the Air Force argues that this delay cannot be done safely, that the ICBM replacement program must begin presently to replace the existing missiles before they are too old or obsolete. My central project is thus an open-source technical analysis of whether the Minuteman III ICBM lifetime could be extended, and an examination of the arguments for building a replacement missile.

The technical issues—Minuteman III fleet lifetime extension

The Minuteman III missiles began deployment in 1970, with a planned 10-year service life. The missile has had continuous upgrades since then, and from 2002 to 2012 the Pentagon performed a comprehensive life extension program that refurbished or replaced the missile

components to maintain the viability of the missiles to 2030, rendering them “basically new missiles except for the shell.” (Pampe 2012)

My work will examine these related questions: How does the Air Force assess the lifetime of its missiles and how conservative or generous is this method compared to other ways of doing so? Are there more meaningful ways to estimate operational lifetimes, and can comparison with other programs, such as the lifetime extension program of the Navy’s Trident D5 missile, provide useful insight? Are there feasible and practicable steps that can be taken to extend the lifetime of the current Minuteman missiles beyond 2030?

Aging of the solid rocket motors are a central factor in the service lifetime of the missiles. The Minuteman III missiles use three solid-fueled rocket stages, and the performance of solid rocket motors are known to change with age. (GAO 1990) The Air Force reportedly estimates motor lifetimes using destructive testing of a small number of them in the decade following production. (Fetter and Reif 2019), and destructive testing is the primary method for surveilling the motors’ aging (Caston 2014). However, given the extensive data collected over years of experience with these systems, other methods are possible, for example, including estimating motor lifetimes from non-destructive data collection and modeling. Because the US Space Force’s Rocket Systems Launch Program (RSLP) uses decommissioned Minuteman motors for space launch, data on the reliability and suitability of Minuteman stages (including age and whether the stage was accepted or rejected for launch or testing, and the results of that use) from more than 300 motors are in the public domain.

These data can help identify the rejection rates of the motors, and the launch success rates of those accepted for use as a function of age and other attributes, which can be compared with the Air Force’s lifetime estimate, as well as the methods used by other groups. For example, the RSLP itself assesses that the Minuteman motors are “currently well beyond design life but continue to show high reliability.” (Riley and Wagner 2011) And the Navy has a similar task with its 27-year-old Trident D-5 missiles; the current life extension program would take the D-5 into the 2040s and the proposed extension program potentially to 2083. (Sherman 2020) Preliminary examination of the public RSLP data available to me indicate that the Air Force’s estimate of a 17-year motor lifetime (GAO 1990) is overly conservative, given that dozens of motors older than 17 years have successfully launched. The low rate of failure of older motors also suggests that nondestructive methods for estimating reliability are sound. If this proves to be the case, the current ICBM fleet could be retained for longer and with less need for attrition due to destructive testing.

Such data support the conclusions of a RAND Corporation study (Caston 2014) that continued advancements in techniques for monitoring and modeling motor aging would likely reduce the

number of flight tests needed to keep confidence in missile performance. I will explore whether it is possible to estimate the required rate of testing given the existing database of hundreds of Minuteman III flight tests.

The technical issues--New ICBM capabilities

In addition to the issue of aging, the Air Force asserts that a new ICBM is needed because the Minuteman III missiles may not be adequate in the future to deal with expected advances in Russian or Chinese missile defenses. The United States has invested significant resources in ballistic missile defense over decades and the results of that work help set a bound to what would be achievable in the next decades for Russia and China.

What improvement might they be seeking? The Air Force may desire the ability to simply avoid missile defenses by traveling the long way around the earth to attack targets from an unplanned-for direction. Another possible rationale for the new missile is to make it physically larger and better designed to carry multiple independently targetable reentry vehicles (MIRVs), one strategy for overwhelming missile defenses. The Minuteman III missile is designed to be able to carry multiple warheads of the older W-78 design but can only carry one of the more recent W87 design. Other possible missile defense countermeasures could be the launch of maneuverable reentry vehicles or more advanced decoy packages. I will examine whether these missions are necessary and whether they might require a new missile.

Expected conclusions and potential pitfalls

If the findings of this study suggest that a lifetime extension program for the Minuteman III missile is sound, this may support a fuller discussion of whether this leg of the triad is in the national interest before a decades-long commitment is made. However, one must cautious: outside efforts to change US nuclear posture and policy in substantial way have found limited success in the past. Bureaucratic inertia and entrenched industrial interests work against making innovative changes. Additionally, because the Biden administration is currently undertaking its Nuclear Posture Review, the decision to move ahead with the GBSD may already be made by the time my project is completed. However, because that program would take many years, this work may continue to have relevance for Congress and those charged with continued oversight.

It is also possible, perhaps likely, that another government agency or independent commission may be tasked with looking at the lifetime extension question. I could use feedback on how to make this work as valuable as possible if that happens, as well as suggestions about how to best anchor the technical work in the larger strategic context.

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3. Sanne Verschuren, CISAC

In Defiance of "The Unthinkable:" Exploring the Intersection Between the Nuclear and Conventional World

Upon witnessing the first nuclear test in the desert of New Mexico in the 1945, Brigadier General Thomas F. Farrell wrote: "The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before."[5] Despite never having expressed any doubt about the use of atomic weapons on Japan, President Harry S. Truman stated in a discussion around the potential military custody of nuclear weapons that: "I don't think we ought to use this thing [the atomic bomb] unless we absolutely have to… You have got to understand that this isn't a military weapon…It is used to wipe out women and children and unarmed people, and not for military uses. So we have got to treat this differently from rifles and cannon and ordinary things like that…"[6] Early on, observers, policymakers, and scholars alike deemed nuclear weapons to be something different, special, and thus exceptional. Ever since the invention of "the bomb," nuclear exceptionalism has thus been the modus operandi.

In recent years, however, several developments seem to challenge the assumption of nuclear exceptionalism. First, nuclear and conventional capabilities have become increasingly intertwined on a strategic and operational level, including through the incorporation of conventional capabilities such as missile defences into nuclear doctrines, the development of dual-use technologies, the interwoven nature of nuclear and conventional command-and-control systems, and their vulnerability to cyber-attacks. In a landmark speech in 2006, for instance, French President Jacques Chirac announced a shift in his country's rigid approach to nuclear deterrence, by declaring that missile defence, a conventional capability, "can complement [nuclear deterrence] by reducing our vulnerabilities" and could thus become part of France's strategy for national defence.[7] Second, there has been a push by some policymakers to "conventionalize" nuclear weapons, meaning efforts to turn these weapons into useable instruments of war. The 2018 U.S. Nuclear Posture Review, for example, called for modifying "a small number of existing SLBM warheads to provide a low-yield option."[8]

Building on these observations, this project posits the following research question: Why and under what conditions do states develop or procure technologies that challenge the assumption

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[5] Quoted in Sherwin Martin J. (eds.) 1977. A World Destroyed: The Atomic bomb and the Grand Alliance. Vintage: New York, USA, p. 312.
[6] *Forrestal Diaries*, 21 July 1948, p. 2373, Quoted in Tannenwald, Nina. 2007. The Nuclear Taboo: The United States and the Non-Use of Nuclear Weapons Since 1945. Cambridge University Press: New York, USA: 110-111.
[7] Jacques Chirac, 19 January 2006, 'Sur La Politique De Défense De La France, Notamment La Dissuasion Nucléaire,' Brest, France.
[8] Office of the Secretary of Defense, February 2018, 'Nuclear Posture Review,' p. XII.

of nuclear exceptionalism? In this project, I aim to analyze the notion of nuclear exceptionalism, by studying how the concept has been constructed, how it has changed over time, and how it has been (re-)produced in nuclear policy. To answer this question, I will first trace the use of the assumption of nuclear exceptionalism in academia and the policy world. In doing so, I will identify the dimensions of nuclear exceptionalism and map out practices that challenge the assumption. I will then turn to two case studies to examine the extent to which notions of nuclear exceptionalism has been reproduced or challenged in the policy community: (1) the development of missile defense in the United States, France, and the United Kingdom from the mid-1980s until today and (2) the debate around the development of tactical nuclear weapons in the United States and France in the 1980s.

Delving deeper into the first case study, my book project—entitled *Imagining the Unimaginable: War, Weapons, and Procurement Politics*—asks: Why and how do states decide to develop different weapon systems within a similar domain of warfare? For example, why does the United States invest in ever-more expansive forms of national missile defense, while France briefly dabbled in such matters and the United Kingdom has been reluctant to do so?

Whereas political scientists have often assumed convergence in the means of warfare across different states, this project aims to understand why states adopt varied, yet empirically observable and analytically distinguishable, force structures within similar domains of warfare. More specifically, I contend that the initial decision to acquire a military capability, such as an aircraft carrier, is just one part of the puzzle. One also needs to examine why states choose to pursue particular kinds of force structures within such a military domain, such as a carrier strike group or escort carriers. My research question thus goes beyond the mere possession of capabilities towards the many different ways that weapon systems can be conceptualized and used.

I capture variation in states' military capabilities with the novel concept of "weapons postures." This is defined as a set of material capabilities, consisting of newly designed or repurposed technologies that have been developed around a "rump technology," related practices of use, and a shared understanding of their role and embeddedness within the state's military apparatus. I propose four types of postures: deterrent, strategic, tactical, and control. First, a *deterrent posture* entails that a state aims to prevent the adversary from doing something by persuading him that the cost of action will far outweigh the perceived benefits. This can be done either by issuing a threat of unacceptable counteraction or through fostering the belief among the adversary that his probability of success in terms of a military action is low. Second, a *strategic posture* pertains to the use of force against countervalue targets, particularly economic infrastructure, leadership, and population. Third, a *tactical posture* involves the use of force

against the adversary's military assets, also referred to as counterforce. Finally, a *control posture* revolves around seizing and holding territory in order to enable one's own military forces to conduct military operations, while denying hostile forces access.

Contrary to arguments that point to the role of systemic threat, the availability of resources, organizational interests, and strategic culture, I argue that states will pursue the development of one of the four weapons postures—deterrent, strategic, tactical, or control—based on whose ideas win out in the domestic political competition over the image of future war. More specifically, domestic actors' ideas about future warfare—what I call the images of warfare, consisting of actors' perceptions of the future threat environment and their theory of victory—shape actors' preferences in terms of what military capabilities they would like to pursue. The power of these images, however, is mediated through the efficacy of the advocacy network built to promote them, as well as the political opportunity structure that determines the level of openness of the state to these new ideas. In order to transform ideas into actual capabilities, I contend that actors need to build a cross-cutting coalition within the broader defense community around their "imagined security interests," using either persuasion or opportunism. Their ability to build a coalition and to funnel their ideas into the decision-making process is in turn shaped by the state's political opportunity structure, which changes across time and space.

I test this theory through a series of in-depth case studies, in which I examine the development and operationalization of missile defense (late 1980s-2020), airpower (1920s-1930s), and aircraft carriers (1950s-1960s) in the United States, France, and the United Kingdom. The latter two technology cases will be included as shadow cases in the book manuscript. To construct these cases, I gathered original archival evidence, visiting eleven different archives and collecting about 65,000 relevant documents. I also conducted seventy-five semi-structured interviews with key defense stakeholders, including members of the armed services, foreign affairs officials, NATO officials, government representatives, politicians and their staff members, defense analysts, and members of civil society. As I develop the book manuscript further, I intend to add another case around the pursuit of aircraft carriers and missile defense in India (summer 2022). In addition to working on the book manuscript, I will use my time at CISAC to produce separate academic articles from this research, including articles on the persistence of missile defense and the impact of missile defense on past and future arms control negotiations.

Turning to the second case study of the project, I propose to conduct an exploratory study on the development of tactical nuclear weapons. These are short-range nuclear weapons that are intended to be used in the theatre of war. While scholarship has effectively separated the nuclear from the conventional world, this is not necessarily how countries' military arsenals have developed. Efforts by a subset of policymakers to "conventionalize" nuclear weapons are a

primary example of this dynamic. In many ways, such weapons constitute a "least likely" case for nuclear exceptionalism. While the push to "conventionalize" nuclear weapons has surfaced multiple times since the onset of the nuclear age, this part of the study focuses on the decision of the United States, as a major power, in the 1980s to deploy new cruise missiles and intermediate-range ballistic missiles in Europe and compares it to the concurrent decision of France, as a middle power, to develop the short-range ASMP air-launched cruise missile. France, it should be noted, has always refused to recognize those missiles as a tactical capability. In terms of evidence, I will draw on archival sources, leaders' memoirs, and secondary literature. In addition, I will visit the French national and military archives, NATO archives, and U.S. national archives and presidential libraries during the winter break of the fellowship. The latter will depend upon developments around COVID-19, which thus constitutes the most vulnerable aspect of my study.

Overall, this project makes the following contributions to the study and practice of international security. First, with the concept of weapons postures, I shift the variable of interest from explaining the mere possession of capabilities to understanding why states pursue particular types of military capabilities. In doing so, this project presents a novel approach to studying both countries' nuclear and conventional capabilities. This is something that existing theories, which tend to focus either on the nuclear or on the conventional realm, struggle with. Second, I demonstrate the importance of ideas, narratives, and imagination as explanatory variables for the development of state's war-fighting capabilities. In the book project, for instance, I contend that ideas about the future matter for material outcomes. In doing so, it brings together two, seemingly contrasting, variables: the agile nature of ideas and the material, expensive, non-fungible nature of weapon systems. Third, my research advocates for a more dynamic understanding of the functioning of institutions. Rather than characterizing the relevant institutions as inherently beneficial for, or impeding, military innovation, I argue that the openness of the institutions to these ideas will differ across states and at various times within a state. Fourth, through this project, I aim to provide tools for the scholarly community to better understand phenomena that straddle the nuclear and the non-nuclear world. Finally, this project has implications for major debates within the policy community. By bridging the gap between the nuclear and non-nuclear world, I hope to better understand how past policy choices were made, including how countries constructed their military arsenals and their justification for doing so. Moreover, I also hope to provide accurate policy advice for future policy choices, particularly thinking through the implications of the increased interwoven nature between nuclear and conventional capabilities for conflict management and nuclear escalation, as well as proposing strategies for arms control that would be better suited for this type of security environment.