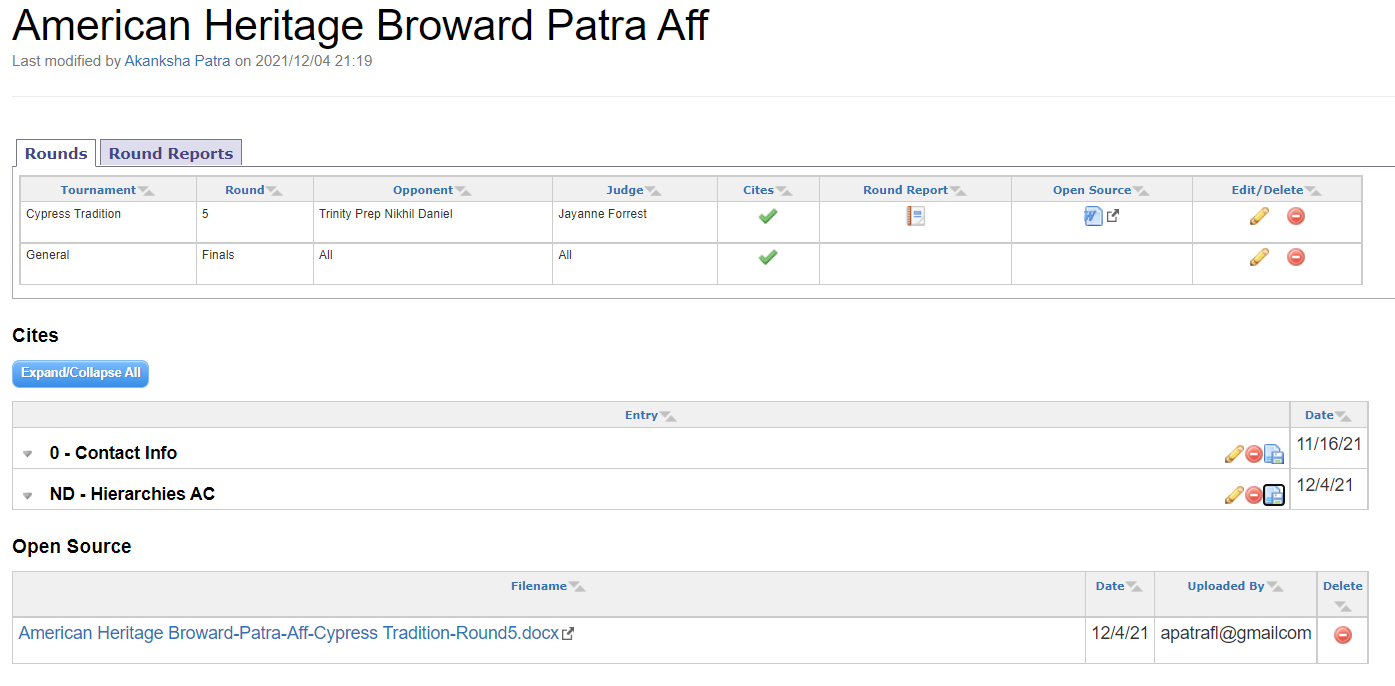
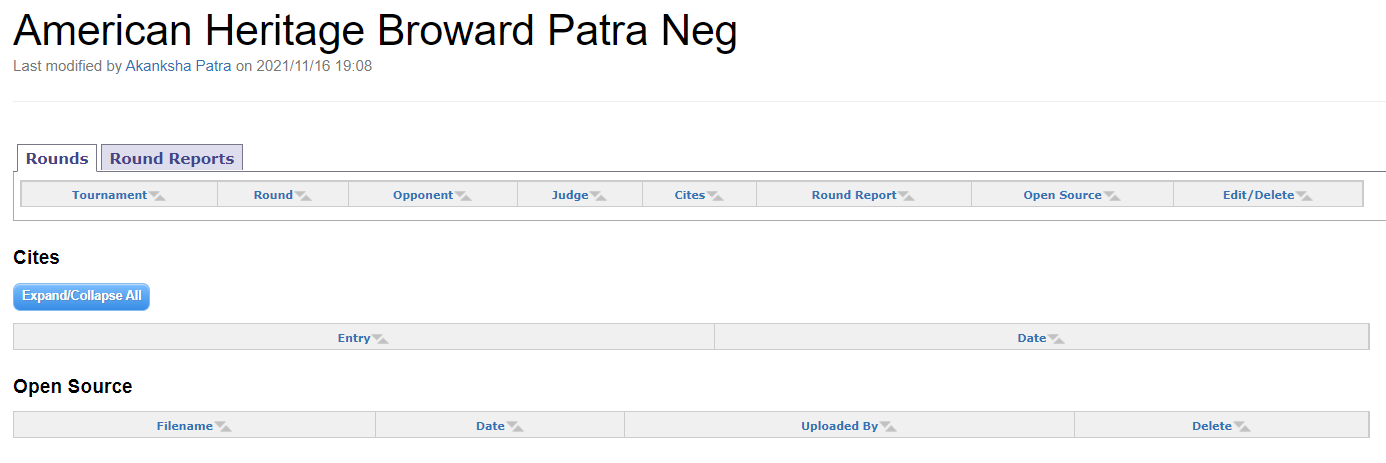
### 1

#### Interpretation: Debaters must disclose all broken constructive positions on open source with highlighting on the 2021-22 NDCA LD wiki under their own names and schools within 30 minutes after the round in which they read them

#### Violation – they don’t – only one round for cypress disclosed and none from the previous 5 rounds of sunvite – they have 0 neg cases disclosed which multiplies our impacts





#### 1] Debate resource inequities—you’ll say people will steal cards, but that’s good—it’s the only way to truly level the playing field for students such as novices in under-privileged programs who can’t bypass paywalled articles.

#### 2] Evidence ethics – open source is the only way to verify pre-round that cards aren’t miscut or highlighted or bracketed unethically. That’s a voter – maintaining ethical ev practices is key to being good academics and we should be able to verify you didn’t cheat

#### 3] Depth of clash – it allows debaters to have nuanced researched objections to their opponents evidence before the round at a much faster rate, which leads to higher quality ev comparison – outweighs cause thinking on your feet is NUQ but the best quality responses come from full access to a case.

#### Fairness – all arguments concede the validity of fairness

#### Education – the only reason schools fund debate

#### Competing interps on theory – A] disclosing is a yes/no question, you can’t reasonably not disclose B] norm setting – reasonability is arbitrary and invites judge intervention C] reasonability causes a race to the bottom.

#### Drop the debater – Sets good norms for the debate space, losing this round will make my opponent disclose next round, Dropping the argument means dropping their case essentially making it a drop the debater

#### No RVIs: 1] Encourages theory baiting and chills checking real abuse. 2] Illogical b/c don’t win for being fair and logic is meta-constraint on arguments because it comes lexically prior.

### Fwk

#### Pleasure and pain are intrinsically valuable. People consistently regard pleasure and pain as good reasons for action,

Moen 16 [(Ole Martin Moen, Research Fellow in Philosophy at University of Oslo) “An Argument for Hedonism,” Journal of Value Inquiry (Springer), 50 (2) 2016: 267–281, <https://link.springer.com/article/10.1007/s10790-015-9506-9>] TDI

Let us start by observing, empirically, that **a widely shared judgment about intrinsic value and disvalue is that pleasure is intrinsically valuable and pain is intrinsically disvaluable.** **On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues.** This inclusion makes intuitive sense, moreover, for **there is something undeniably good about the way pleasure feels and something undeniably bad about the way pain feels, and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have.** “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative.2 **The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values.** If you tell me that you are heading for the convenience store, **I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so**, not merely for the sake of going to the convenience store, but **for the sake of achieving something further that you deem to be valuable.** You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” **If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good.**3 As Aristotle observes**: “We never ask [a man] what his end is in being pleased, because we assume that pleasure is choice worthy in itself.**”

#### Moral uncertainty means preventing extinction should be our highest priority.

Bostrom 12 [(Nick Bostrom, Faculty of Philosophy & Oxford Martin School University of Oxford) “Existential Risk Prevention as Global Priority.” Global Policy, 2012] TDI

These reflections on moral uncertainty suggest an alternative, complementary way of looking at existential risk; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate.¶ Our present understanding of axiology might well be confused. We may not now know — at least not in concrete detail — what outcomes would count as a big win for humanity; we might not even yet be able to imagine the best ends of our journey. If we are indeed profoundly uncertain about our ultimate aims, then we should recognize that there is a great option value in preserving — and ideally improving — our ability to recognize value and to steer the future accordingly. Ensuring that there will be a future version of humanity with great powers and a propensity to use them wisely is plausibly the best way available to us to increase the probability that the future will contain a lot of value. To do this, we must prevent any existential catastrophe.

### AC – Exploration Advantage

#### Space exploration is essential to the survival of humanity. Russia—

#### Deep space exploration is a shared goal that prevents escalation of US-Russia tensions. But privatization threatens it independent of our other internal links

CSIS 18 [(Center for Strategic and International Studies), “Why Human Space Exploration Matters,” August 21, 2018 https://www.csis.org/blogs/post-soviet-post/space-cooperation] TDI

U.S.-Russian space cooperation continues to be a stated mutual goal. In April 2018, President Putin said of space, “Thank God, this field of activity is not being influenced by problems in politics. Therefore, I hope that everything will develop, since it is in the interests of everyone…This is a sphere that unites people. I hope it will continue to be this way.” During his statement at a recent event at CSIS, NASA Administrator Jim Bridenstine said, “[space] is our best opportunity to dialogue when everything else falls apart. We’ve got American astronauts and Russian cosmonauts dependent on each other on the International Space Station, which enables us to ultimately maintain that dialogue.” The U.S. and Russia both benefit from the ISS partnership. Russia provides transportation to the ISS for U.S. astronauts, from which Russia receives an average of $81 million per seat on the Soyuz (and recognition of its status as a space power). The U.S. also benefits from Russia’s technical contributions to the ISS while Russia benefits The U.S. and Russia signed a joint statement in 2017 in support of the idea of collaborating on deep space exploration, including the construction of the Lunar Orbital Platform-Gateway, a research-focused space station orbiting the moon. Through agreements on civilian space exploration, such as the Lunar Orbital Platform-Gateway or future Mars projects, that have clear benefits to both sides, some degree of cooperation will remain in both countries’ interest. The high price tag for pursuing space exploration alone and opportunities for sharing and receiving technical expertise encourages international partnerships like the ISS. However, at least three factors, apart from the overall deterioration of U.S.-Russia relations, threaten this cooperation. First, growth of the private sector space industry may alter the economic arrangement between the U.S. and Russia, and ultimately lower the benefits of cooperation to both countries. The development of advanced technologies by private companies will give NASA new options to choose from and reduce the need to depend on (and negotiate with) Russia. If NASA and its Russian counterpart, Roskosmos, have no need to talk with one another, they probably won’t in the face of tense political relations. The U.S. intends to use Boeing and SpaceX capsules for human spaceflight beginning in 2020, and a Congressional plan in 2016 set a phase out date of Russian RD-180 rocket engines by 2022.

#### It’s make or break for the relationship—Ukraine, decline of US moral authority on international affairs puts us at the brink of the end of Russian diplomacy and even war

Weir 21 [(Fred Weir has been the Monitor's Moscow correspondent, covering Russia and the former Soviet Union, since 1998. He's traveled over much of that vast territory, reporting on stories ranging from Russia's financial crash to the war in Chechnya, creeping Islamization in central Asia, Russia's demographic crisis, the rise of Vladimir Putin and his repeated returns to the Kremlin, and the ups and downs of US-Russia relations). “Worse than the Cold War? US-Russia relations hit new low.“ Christian Science Monitor 4-20-2021 https://www.csmonitor.com/World/Europe/2021/0420/Worse-than-the-Cold-War-US-Russia-relations-hit-new-low] TDI

Russia’s relations with the West, and the United States in particular, appear to be plumbing depths of acrimony and mutual misunderstanding unseen even during the original Cold War.After years of deteriorating relations, sanctions, tit-for-tat diplomatic expulsions, and an escalating “information war,” some in Moscow are asking if there even is any point in seeking renewed dialogue with the U.S., if only out of concern that more talking might just make things worse. Events have cascaded over the past month. Russia’s treatment of imprisoned dissident Alexei Navalny, who has been sent to a prison hospital amid reports of failing health, underlines the sharp perceived differences between Russia and the West over matters of human rights. Meanwhile, a Russian military buildup near Ukraine has illustrated that the conflict in the Donbass region might explode at any time, possibly even dragging Russia and NATO into direct confrontation. With its relations with Washington at a nadir, Russia is eyeing a more pragmatic, if adversarial, relationship with the U.S. in the hopes of getting the respect it desires. President Joe Biden surprised the Kremlin by proposing a “personal summit” to discuss the growing list of U.S.-Russia disagreements in a phone conversation with Vladimir Putin last week. He later spoke of the need for “disengagement” in the escalating tensions around Ukraine, and postponed a planned visit of two U.S. warships to Russia-adjacent waters in the Black Sea. But days later he also imposed a package of tough sanctions against Russia, for its alleged SolarWinds hacking and interference in the 2020 U.S. presidential elections, infuriating Moscow and drawing threats of retaliation. Last month, after Mr. Biden agreed with a journalist’s intimation that Mr. Putin is a “killer,” the Kremlin ordered Russia’s ambassador to the U.S. to return home for intensive consultations, an almost unprecedented peacetime move. Over the weekend, Russian Foreign Minister Sergey Lavrov suggested that the acting U.S. ambassador to Moscow, John Sullivan, should likewise go back to Washington for a spell. On Tuesday, Mr. Sullivan announced he would do just that this week. And there is a growing sense in Moscow that the downward spiral of East-West ties has reached a point of no return, and that Russia should consider abandoning hopes of reconciliation with the West and seek permanent alternatives: perhaps in an intensified compact with China, and targeted relationships with countries of Europe and other regions that are willing to do business with Moscow. “Things are at rock bottom. This may not be structurally a cold war in the way the old one was, but mentally, in terms of atmosphere, it’s even worse,” says Fyodor Lukyanov, editor of Russia in Global Affairs, a Moscow-based foreign policy journal. “The fact that Biden offered a summit meeting would have sounded a hopeful note anytime in the past. Now, nobody can be sure of that. A hypothetical Putin-Biden meeting might not prove to be a path to better relations, but just the opposite. It could just become a shouting match that would bring a hardening of differences, and make relations look like even more of a dead end.” Room for discussion Foreign policy experts agree that there is a long list of practical issues that could benefit from purposeful high-level discussion. With the U.S. preparing to finally exit Afghanistan, some coordination with regional countries, including Russia and its Central Asian allies, might make the transition easier for everyone. One of Mr. Biden’s first acts in office was to extend the New START arms control agreement, which the Trump administration had been threatening to abandon, but the former paradigm of strategic stability remains in tatters and requires urgent attention, experts say. “If you are looking for opportunities to make the world a safer place through reason and compromise, there are quite a few,” says Andrey Kortunov, director of the Russian International Affairs Council, which is affiliated with the Foreign Ministry. “There are also some areas where the best we could do is agree to disagree, such as Ukraine and human rights issues.” The plight of Mr. Navalny, which has evoked so much outrage in the West, seems unlikely to provide leverage in dealing with the Kremlin because – as Western moral authority fades – Russian public opinion appears indifferent, or even in agreement with its government’s actions. Recent surveys by the Levada Center in Moscow, Russia’s only independent pollster, found that fewer than a fifth of Russians approve of Mr. Navalny’s activities, while well over half disapprove. An April poll found that while 29% of Russians consider Mr. Navalny’s imprisonment unfair, 48% think it is fair. Russian opposition figure Alexei Navalny, shown here during a hearing in the Babuskinsky District Court in Moscow Feb. 12, 2021, is in poor health amid his hunger strike while in prison in Russia. He was recently moved to a prison hospital. Tensions around the Russian-backed rebel republics in eastern Ukraine have been much severer than usual, with a spike in violent incidents on the front line, a demonstrative Russian military buildup near the borders, and strong U.S. and NATO affirmations of support for Kyiv. The Russian narrative claims that Ukrainian President Volodymyr Zelenskiy triggered the crisis a month ago by signing a decree that makes retaking the Russian-annexed territory of Crimea official Ukrainian state policy. Mr. Zelenskiy has also appealed to the U.S. and Europe to expedite Ukraine’s membership in NATO, which Russia has long described as a “red line” that would lead to war. But Russian leaders, who have been at pains to deny any direct involvement in Ukraine’s war for the past seven years, now say openly that they will fight to defend the two rebel republics. Top Kremlin official Dmitry Kozak even warned that if conflict erupts, it could be “the beginning of the end” for Ukraine. “This is a very desperate situation,” says Vadim Karasyov, director of the independent Institute of Global Strategies in Kyiv. “We know the West is not going to help Ukraine militarily if it comes to war. So we need to find some kind of workable compromises, not more pretexts for war.” Time to turn eastward? In this increasingly vexed atmosphere, the Russians appear to be saying there is no point in Mr. Putin and Mr. Biden meeting unless an agenda has been prepared well in advance, setting out a few achievable goals and leaving aside areas where there can be no agreement. “Russia isn’t going to take part in another circus like we had with Trump in Helsinki in 2018,” says Sergei Markedonov, an expert with MGIMO University in Moscow. “What is needed is a deeper dialogue. That could begin if we had a real old-fashioned summit between Biden and Putin, one that has been calculated to yield at least some positive results. We need to find a modus vivendi going forward, and the present course is not leading there.” Alternatively, Russia may turn away from any hopes of even pragmatic rapprochement with the West, experts warn. Mr. Lukyanov, who maintains close contact with his Chinese counterparts, says they felt blindsided at a summit with U.S. foreign policy chiefs in Alaska last month, when what they expected to be a practical discussion of how to overcome the acrimonious Trump-era legacy in their relations turned into what they saw as a U.S. lecture about how China needs to obey the “rules-based” international order. “It was the Chinese, in the past, who were very cautious about participating” in anything that looked like an anti-Western alliance, says Mr. Lukyanov. “We are hearing a new tone from them now. Now our growing relationship with China isn’t just about compensating for a lack of relations with the U.S. It’s about the need to build up a group of countries that will resist the U.S., aimed at containing U.S. activities and policies that are harmful to our two countries.”

#### Space weapons heighten potential for escalation and make perceptions of US-Russia space conflict key.

Alexey Arbatov et al, head of the Center for International Security at the Primakov National Research Institute of World Economy and International Relations, Major General Vladimir Dvorkin, a principal researcher at the Center for International Security at the Primakov National Research Institute of World Economy and International Relations and Peter Topychkanov, fellow at the Carnegie Moscow Center’s Nonproliferation Program, ‘17 “Russian And Chinese Perspectives On Non-Nuclear Weapons And Nuclear Risks” *Carnegie Endowment for International Peace Publications,* <https://www.russiamatters.org/sites/default/files/media/files/Entanglement_interior_FNL.pdf>

Against this background, Russian military and technical experts are currently engaged in efforts to elaborate strategies for fighting an air-space war. The following is an attempt to frame such an integrated doctrine by one of its main theoreticians, Colonel Yuri Krinitsky from the Military Air-Space Defense Academy: “The integration of aerial and space-based means of attack has transformed airspace and space into a specific field of armed conflict: an air-space theater of military operations. United, systematically organized actions of [U.S.] air-space power in this theater should be countered with united and systematically organized actions by the Russian Air-Space Defense Forces. This is required under the National Security Strategy of the Russian Federation and Air-Space Defense Plan approved by the Russian president in 2006.”6 This document goes on to list the tasks of the Air-Space Defense Forces as “monitoring and reconnaissance of the airspace situation; identifying the beginning of an aerial, missile, or space attack; informing state organs and the military leadership of the Russian Federation about it; repelling air-space attacks; and defending command sites of the top levels of state and military command authorities, strategic nuclear forces’ groupings, and the elements of missile warning systems.”7 While picking apart in detail the organizational, operational, and technical aspects of the Air-Space Defense Forces (now part of the Air-Space Forces),8 military analysts step around the basic question of what constitutes “the means of air-space attack” (SVKN in Russian, MASA in English). This term and “air-space attack” are broadly used in official documents (including the Military Doctrine) and statements, as well as in the new names of military organizations (such as the Air-Space Forces), and in a seemingly infinite number of professional articles, books, and pamphlets. If MASA refers to aircraft and cruise missiles, then what does space have to do with it? To be sure, various military communication and intelligence, reconnaissance, and surveillance satellites are based in space, but these assets also serve the Navy and Ground Forces without the word “space” tacked onto their names. If MASA refers to long-range ballistic missiles, which have trajectories that pass mostly through space, then this threat is not new but has existed for more than sixty years. There was—and still is—no defense against a massive ballistic missile strike, and none is likely in the future in spite of U.S. and Russian efforts at missile defense. In the past (and possibly now), one of the possible tasks of ballistic missiles was to break “corridors” in the enemy’s air-defense system to enable bombers to penetrate it. But with ballistic missiles being armed with more warheads with improved accuracy, and with the advent of longrange air-launched cruise missiles, it is increasingly unnecessary for bombers to be able to penetrate enemy air defenses. Coordination between air and notional “space” systems has apparently moved to the background of strategic planning. Anyway, this tactic was never considered as air-space warfare before now. MASA may be used in reference to potential hypersonic boost-glide weapons, which are discussed below. But their role and capabilities are not yet known, so it would clearly be premature to build the theory of air-space war on them, and even more so to start creating defenses against them. In any case, referring to those weapons as MASA is farfetched: besides a short boost phase, their entire trajectory is in the upper atmosphere at speeds greater than airplanes but lower than ballistic missiles. It is, therefore, even less apt to describe such systems as space arms than it is to refer to traditional long-range ballistic missiles as such. Finally, as for theoretically possible space-based weapons that would conduct strikes against targets on the ground, at sea, and in the air, they do not yet exist, and their future viability is far from clear. Even if the concept of air-space war is ill-defined, the military and technical experts who propound it reach a predictable conclusion with regard to the capabilities needed to fight one. They typically argue that Russia needs “to counter the air-space attack system with an air-space defense system. . . . A prospective system for destroying and suppressing MASA should be a synergy of anti-missile, anti-satellite, and air-defense missiles, and air units, and radio-electronic warfare forces. And its composition should be multilayered.”9 Such calls are being translated into policy. Most notably, the air-space defense program, for which the military’s top brass and industrial corporations lobbied, is the single largest component of the State Armaments Program through 2020, accounting for about 20 percent of all costs when the program was first announced in 2011—about 3.4 trillion rubles ($106 billion at the time).10 Along with the modernization of the missile early-warning system by the development and deployment of new Voronezh-type land-based radars and missile-launch detection satellites, the program envisages the deployment of twenty-eight missile regiments of S-400 Triumph air-defense systems (about 450 to 670 launchers), and thirty-eight battalions equipped with the next-generation S-500 Vityaz (recently renamed Prometey) systems (300 to 460 launchers).11 In total, the plan is to manufacture up to 3,000 missile interceptors of the two types, for which three new production plants were built. A new integrated and fully automatic command-and-control system is being created to facilitate operations by the Air-Space Defense Forces. The Moscow A-135 missile defense system (now renamed A-235) is being modernized with non-nuclear kinetic interceptors to engage incoming ballistic missiles (previously the interceptors were armed with nuclear warheads).12 The current Russian economic crisis, which has resulted in defense budget cuts in fiscal year 2017, may slow down the air-space armament programs and the scale of arms procurement, but the underlying momentum will be unaffected unless stopped or redirected by a major change in Russia’s defense posture. In a sense, Russian policy may be explained by the visceral desire of the military to break out from the deadlock—the “strangulating effect”—of mutual assured nuclear destruction, which has made further arms development, high-technology competition, and supposedly fascinating global war scenarios senseless (indeed, it prompted U.S. and Soviet leaders of the 1970s and 1980s to agree that, as then U.S. president Ronald Reagan put it, “a nuclear war cannot be won and must never be fought.”13) During the four decades of the Cold War, several generations of the Soviet military and defense industrial elite had learned and become accustomed to competing with the most powerful possible opponent, the United States, and such competition became their raison d’être. The end of the Cold War and of the nuclear arms race in the early 1990s deprived them of this supposedly glorious quest, and opposing rogue states and terrorists was not a noble substitute. U.S. and NATO operations in Yugoslavia and Iraq, however, provided a new hightechnology challenge, defined in Russia as air-space warfare, which was eagerly embraced as a new and fascinating domain of seemingly endless competition with a worthy counterpart. Besides, this new dimension of warfare doubtless gave the military and associated defense industries an opportunity to impress political leadership with newly discovered esoteric and frightening threats, justifying the prioritization of national defense, and hence arms procurement programs and large defense budgets. In any case, the Russian strategy for air-space war is directly connected to the problem of entanglement. Astonishingly—and this makes the concept look quite scholastic—its framers shed no light on the single most important question: Is the context for air-space war a global (or regional) nuclear war, or a non-nuclear war that pits Russia against the United States and NATO? If it is the former, then in the event of the large-scale use of ballistic missiles armed with nuclear warheads (and in the absence of effective missile defense systems), the Russian Air-Space Forces would be unlikely to function effectively. Except for issuing warnings about incoming missile attacks, they would not be able to fulfill the tasks assigned to them by Russia’s Military Doctrine, including “repelling air-space attacks and defending command sites of the top levels of state and military administration, strategic nuclear forces’ units, and elements of missile warning systems.”14 Alternatively, if air-space war assumes a non-nuclear conflict, then the concept raises serious doubts of a different nature. Russian state and military leaders have regularly depicted terrifying scenarios of large-scale conflicts being won through non-nuclear means. Former deputy defense minister General Arkady Bakhin, for example, has described how “leading world powers are staking everything on winning supremacy in the air and in space, on carrying out massive air-space operations at the outbreak of hostilities, to conduct strikes against sites of strategic and vital importance all across the country.”15 It is difficult to imagine, however, that such a conflict, in reality, would not quickly escalate to a nuclear exchange, especially as strategic forces and their C3I systems were continually attacked by conventional munitions. Right up until the mid-1980s, the military leadership of the USSR believed that a major war would likely begin in Europe with the early use by Warsaw Pact forces of hundreds of tactical nuclear weapons “as soon as [they] received information” that NATO was preparing to launch a nuclear strike.16 After that, Soviet armies would reach the English Channel and the Pyrenees in a few weeks, or massive nuclear strikes would be inflicted by the USSR and the United States on one another, and the war would be over in a few hours, or at most in a few days, with catastrophic consequences.17 After the end of the Cold War, the task of elaborating probable major war scenarios was practically shelved because such a war had become unthinkable in the new political environment. However, strategic thinking on the next high-technology global war apparently continued in secret (and probably not only in Russia). Now, at a time of renewed confrontation between Russia and the West, the fruits of that work are finally seeing the light of day. In all likelihood, the authors of the strategy imagine that over a relatively long period of time—days or weeks—the West would wage a campaign of air and missile strikes against Russia without using nuclear weapons. Russia, in turn, would defend against such attacks and carry out retaliatory strikes with long-range conventional weapons. Notably, in 2016, Russian Defense Minister Sergei Shoigu stated that “by 2021, it is planned to increase by four times the combat capabilities of the nation’s strategic non-nuclear forces, which will provide the possibility of fully implementing the tasks of non-nuclear deterrence.”18 In other words, the basic premise is that the U.S.-led campaigns against Yugoslavia in 1999 or Iraq in 1990 and 2003 (which are often cited by experts in this context) may be implemented against Russia—but with different results, thanks to the operations of the Russian Air-Space Forces, the Strategic Rocket Forces, and the Navy against the United States and its allies. The emphasis on defensive and offensive strategic non-nuclear arms does not exclude, but—on the contrary—implies the limited use of nuclear weapons at some point of the armed conflict. Sergei Sukhanov, one of the most authoritative representatives of the defense industries as the constructor general of the Vympel Corporation, which is responsible for designing strategic defense systems, has exposed the whole panorama of Russia’s contemporary strategic logic on the interactions between offensive and defensive systems and between nuclear and non-nuclear systems: If we cannot exclude the possibility of the large-scale use of air-space attacks by the U.S. and other NATO countries (i.e., if we accept that the Yugoslavian strategy might be applied against Russia), then it is clearly impossible to solve the problem by fighting off air-space attacks with weapons that would neutralize them in the air-space theater, since this would require the creation of highly effective air- and missile defense systems across the country. Therefore, the strategy for solving the air-space defense tasks faced in this eventuality should be based on deterring the enemy from large-scale air-space attacks by implementing the tasks facing air-space defense in this eventuality at a scale that would avoid escalation but force the enemy to refrain from further airspace attack.19 (Emphasis added.) In other words, because of the inevitable limitations in Russia’s ability to defend against air-space attacks, Sukhanov argues that Russia may have to resort to the limited use of nuclear weapons in order to compel the United States and its allies into backing down. This basic logic is widely accepted in Russia. Judging by the available information, the United States does not have—and is not expected to have for the foreseeable future—the technological means or the operational plans to wage non-nuclear air-space warfare against Russia. However, the fact that a major war with the United States and NATO is *seen* in contemporary Russian strategic thinking as a prolonged endeavor involving an integrated technological and operational continuum of nuclear and non-nuclear operations, defensive and offensive capabilities, and ballistic and aerodynamic weapons creates a breeding ground for entanglement. The result could be the rapid escalation of a local non-nuclear conflict to a global nuclear war. The remainder of this chapter discusses how new and emerging military technologies might contribute to such an escalation.

#### Nuke war causes extinction – it won’t stay limited

Edwards 17 [(Paul N. Edwards, CISAC’s William J. Perry Fellow in International Security at Stanford’s Freeman Spogli Institute for International Studies. Being interviewed by EarthSky/card is only parts of the interview directly from Paul Edwards.) “How nuclear war would affect Earth’s climate,” EarthSky, September 8, 2017, earthsky.org/human-world/how-nuclear-war-would-affect-earths-climate] TDI

We are not talking enough about the climatic effects of nuclear war. The “nuclear winter” theory of the mid-1980s played a significant role in the arms reductions of that period. But with the collapse of the Soviet Union and the reduction of U.S. and Russian nuclear arsenals, this aspect of nuclear war has faded from view. That’s not good. In the mid-2000s, climate scientists such as Alan Robock (Rutgers) took another look at nuclear winter theory. This time around, they used much-improved and much more detailed climate models than those available 20 years earlier. They also tested the potential effects of smaller nuclear exchanges. The result: an exchange involving just 50 nuclear weapons — the kind of thing we might see in an India-Pakistan war, for example — could loft 5 billion kilograms of smoke, soot and dust high into the stratosphere. That’s enough to cool the entire planet by about 2 degrees Fahrenheit (1.25 degrees Celsius) — about where we were during the Little Ice Age of the 17th century. Growing seasons could be shortened enough to create really significant food shortages. So the climatic effects of even a relatively small nuclear war would be planet-wide. What about a larger-scale conflict? A U.S.-Russia war currently seems unlikely, but if it were to occur, hundreds or even thousands of nuclear weapons might be launched. The climatic consequences would be catastrophic: global average temperatures would drop as much as 12 degrees Fahrenheit (7 degrees Celsius) for up to several years — temperatures last seen during the great ice ages. Meanwhile, smoke and dust circulating in the stratosphere would darken the atmosphere enough to inhibit photosynthesis, causing disastrous crop failures, widespread famine and massive ecological disruption. The effect would be similar to that of the giant meteor believed to be responsible for the extinction of the dinosaurs. This time, we would be the dinosaurs. Many people are concerned about North Korea’s advancing missile capabilities. Is nuclear war likely in your opinion? At this writing, I think we are closer to a nuclear war than we have been since the early 1960s. In the North Korea case, both Kim Jong-un and President Trump are bullies inclined to escalate confrontations. President Trump lacks impulse control, and there are precious few checks on his ability to initiate a nuclear strike. We have to hope that our generals, both inside and outside the White House, can rein him in. North Korea would most certainly “lose” a nuclear war with the United States. But many millions would die, including hundreds of thousands of Americans currently living in South Korea and Japan (probable North Korean targets). Such vast damage would be wrought in Korea, Japan and Pacific island territories (such as Guam) that any “victory” wouldn’t deserve the name. Not only would that region be left with horrible suffering amongst the survivors; it would also immediately face famine and rampant disease. Radioactive fallout from such a war would spread around the world, including to the U.S. It has been more than 70 years since the last time a nuclear bomb was used in warfare. What would be the effects on the environment and on human health today? To my knowledge, most of the changes in nuclear weapons technology since the 1950s have focused on making them smaller and lighter, and making delivery systems more accurate, rather than on changing their effects on the environment or on human health. So-called “battlefield” weapons with lower explosive yields are part of some arsenals now — but it’s quite unlikely that any exchange between two nuclear powers would stay limited to these smaller, less destructive bombs.

#### debris—

#### Commercial rocket launches produce space clutter—increased debris could reach a tipping point

Thompson 20 [(Clive, author of Coders: The Making of a New Tribe and the Remaking of the World, a columnist for Wired magazine, and a contributing writer to The New York Times Magazine) “Monetizing the Final Frontier The strange new push for space privatization,” December 3, 2020 <https://newrepublic.com/article/160303/monetizing-final-frontier>] TDI

“Physics tells us that two things can’t occupy the same space at the same time or else bad things happen,” Jah said dryly. Indeed, there’s already been one collision that produced sprawling orbital pollution. In 2009, a satellite owned by the U.S. firm Iridium slammed into a decommissioned Russian government satellite at more than 26,000 mph. The crash produced 2,300 pieces of debris, spraying off in all directions. And debris is a particularly gnarly problem in space, because when it’s traveling at thousands of miles an hour, even a marble-size chunk is like a bullet, capable of rendering a damaged satellite inoperable and unsteerable—the owner can no longer fire its boosters to guide it into a higher or lower orbit. There are currently an estimated 500,000 marble-size chunks up there. Decades of space travel by governments left plenty of refuse, ranging from parts of rocket boosters to stray bits of scientific experiments. One particularly grim vision of the future that haunts astronomers is the “Kessler syndrome,” proposed by the astrophysicist Donald Kessler in 1978. Kessler hypothesized that space clutter could reach a tipping point: One really bad collision could produce so much junk that it would trigger a chain reaction of collisions. This disaster scenario would leave hundreds of satellites eventually destroyed, and create a ring of debris that would make launching any new satellites impossible, forever. “Near space is finite—it’s a finite resource,” Jah said. “So now you have this growing trash problem that isn’t being remediated.... And if we exceed the capacity of the environment to carry all this traffic safely, then it becomes unusable.” That’s why a growing chorus of critics are already making the case that space is the next major environmental area to protect, after the oceans and land on Earth. “People seem to really treat resources in space as being infinite,” said Erika Nesvold, an astrophysicist who’s the cofounder of The JustSpace Alliance. “As we’ve seen, people don’t really intuitively understand exponential growth.” That’s the dilemma in a nutshell: The available room in the sky is limited, but the plans for growth are exponential. SpaceX isn’t the only New Space firm looking to toss up satellites. Satellite and rocket start-ups are now lining up en masse, atop new waves of investment. There are satellites geared up to connect to “the internet of things” so companies can communicate among proprietary networks of household devices. There are floating cameras pointing down—so as to gather “geospatial intelligence,” which is to say data streamed from “the vantage point you get from satellites looking down on Earth and giving us information about our planet,” as the venture capitalist Anderson told me. And new forms of satellite vision are emerging all the time, such as cameras that can see at night, or are specially designed to see agriculture. Experiments abound, and so satellite launches will inevitably multiply in their wake. Part of what makes near-Earth orbit so chaotic is that it is, at the moment, remarkably unregulated—not unlike the internet of the early ’90s. An American firm has to get permission from the Federal Communications Commission to launch a satellite, but once it’s in orbit, there’s no federal agency that can compel it to move out of the path of a collision. Satellite owners generally don’t like to move if they can avoid it, because their satellites have a limited amount of fuel; any movement decreases their usable lifespan. On top of that, there are dozens of nations shooting satellites into low-Earth orbit—but no international body coordinating their flight paths. Last fall, the European Space Agency realized one of SpaceX’s new Starlink satellites was on a dangerously close path to an ESA satellite. SpaceX said it had no plans to move the satellite; so the ESA decided to fire its thrusters and get clear. This high-stakes negotiation was conducted via email. What’s more, space debris is extremely hard to source. If a British satellite slams into yours, you can probably figure out who hit you. But if your satellite is wrecked by a random piece of junk, nobody has any clue where that debris came from. It is, in this way, a neat parallel to the problem of C02, where a ceaseless barrage of tiny commercial decisions creates a sprawling problem—one that’s all but designed to ensure that everyone who caused it can deny responsibility. And damage is asymmetric: A company with a small $60,000 satellite could smash into a wildly expensive one paid for by U.S. taxpayers. “A National Reconnaissance Office satellite is at least a billion dollars, if not more, so they have a lot more to lose if something hits a satellite,” Bhavya Lal, a researcher at the IDA Science and Technology Policy Institute, noted. “As more private activity starts to happen, there’s more chances of that loss of control, too.” One might dismiss all this anxiety as a sort of sci-fi version of hippie environmentalism—except that even the administrator of NASA is deeply worried about the chaos and destruction likely to be sown by commercial activity in near-Earth orbit. Jim Bridenstine, the Trump-appointed head of NASA, is as pro-market as one can be. He praises SpaceX every chance he gets; he talks about privatizing the space station. But when I asked him about the looming danger of space debris, during a press-conference call, he conceded that it’s a huge, unresolved issue.

#### Space dust wrecks satellites and debris exponentially spirals

Intagliata 17 [(Christopher Intagliata, MA Journalism from NYU, Editor for NPRs All Things Considered, Reporter/Host for Scientific American’s 60 Second Science) “The Sneaky Danger of Space Dust,” Scientific American, May 11, 2017, <https://www.scientificamerican.com/podcast/episode/the-sneaky-danger-of-space-dust/>] TDI

When tiny particles of space debris slam into satellites, the collision could cause the emission of hardware-frying radiation, Christopher Intagliata reports. Aside from all the satellites, and the space station orbiting the Earth, there's a lot of trash circling the planet, too. Twenty-one thousand [baseball-sized chunks](https://www.scientificamerican.com/article/orbital-debris-space-fence/) of debris, [according to NASA](https://www.orbitaldebris.jsc.nasa.gov/faq.html). But that number's dwarfed by the number of small particles. There's hundreds of millions of those. "And those smaller particles tend to be going fast. Think of picking up a grain of sand at the beach, and that would be on the large side. But they're going 60 kilometers per second." Sigrid Close, an applied physicist and astronautical engineer at Stanford University. Close says that whereas mechanical damage—like punctures—is the worry with the bigger chunks, the dust-sized stuff might leave more insidious, invisible marks on satellites—by causing electrical damage. "We also think this phenomenon can be attributed to some of the failures and anomalies we see on orbit, that right now are basically tagged as 'unknown cause.'" Close and her colleague Alex Fletcher modeled this phenomenon mathematically, based on plasma physics behavior. And here's what they think happens. First, the dust slams into the spacecraft. Incredibly fast. It vaporizes and ionizes a bit of the ship—and itself. Which generates a cloud of ions and electrons, traveling at different speeds. And then: "It's like a spring action, the electrons are pulled back to the ions, ions are being pushed ahead a little bit. And then the electrons overshoot the ions, so they oscillate, and then they go back out again.” That movement of electrons creates a pulse of electromagnetic radiation, which Close says could be the culprit for some of that electrical damage to satellites. The study is in the journal Physics of Plasmas. [Alex C. Fletcher and Sigrid Close, [Particle-in-cell simulations of an RF emission mechanism associated with hypervelocity impact plasmas](http://aip.scitation.org/doi/full/10.1063/1.4980833)]

#### Privatized space tourism increases collision risks due to orbital debris.

Tehrani 4/1 [(James, Editor in Chief of Spark Magazine) “Space Junk: A Safety and Sustainability Problem Moving at 18,000 MPH,” April 1, 2021, <https://sphera.com/spark/space-junk-a-safety-and-sustainability-problem-moving-at-18000-mph/>] TDI

Most of the current debris is found in the low Earth orbit (LEO), which is about 600 to 1,200 miles (1,000 to 2,000 kilometers) above the planet. NASA calls LEO an “orbital space junkyard.” The junk isn’t sitting idly in a landfill; it is moving around at speeds up to 18,000 mph (29,000 kph), or 23 times the speed of sound. While the Inter-Agency Space Debris Coordination Committee was designed to coordinate space debris efforts, there are currently no international laws in place regarding removing space debris. Since a single satellite can cost between $50 million and $400 million, the risk of damage from space debris to a satellite is clearly significant. And as more debris is left behind, there is obviously more risk of collisions, especially when space tourism picks up. The orbiting junk was explored in the 2013 film “Gravity,” starring George Clooney and Sandra Bullock; it’s known as the Kessler Effect. Don Kessler, the former NASA scientist who studied space debris even told the Guardian back in 2011 in regard to formulating a plan to deal with space junk: “The longer you wait to do this, the more expensive it’s going to be. … This scenario of increasing space debris will play out even if we don’t put anything else in orbit,” he said. On that point, the European Space Agency has contracted with a Swiss startup called ClearSpace that plans to launch its first mission to remove space debris in 2025. The Gravity of the Situation Without a doubt, space debris is an Operational Risk; even the International Space Station has to dodge space junk at times. Former NASA Administrator Jim Bridenstine even tweeted last September that the “Space Station has maneuvered 3 times in 2020 to avoid debris. In the last 2 weeks, there have been 3 high concern potential conjunctions. Debris is getting worse!” Some of the larger debris that doesn’t burn up re-entering the atmosphere (about one object per day) even crashes back on Earth. Since most of the Earth’s surface is covered in water, it’s not surprisingly that most of the junk winds up in oceans, so the risk to humans is statistically very low. That doesn’t mean nil though. For example, there is debris from Russian Proton rockets that has been found in Siberia, including that of old fuel tanks containing toxic fuel residue, which can be harmful to plants, animals and humans. The environmental risks of space junk need to be explored further. A piece of space junk floating through the ocean is certainly not nearly as concerning as our plastic problem, but it’s nothing to ignore either. LCA Leads the Way Just as more and more companies are assessing the Life Cycle Assessment (LCA) of their products and services from cradle to grave on Planet Earth, it stands to reason that LCA could be just as important in outer space. That’s especially true when you consider space tourism is poised to blast off to become a potential $1.5 billion industry by 2028. The more activity, the more debris.

#### Early warning satellites going dark signals attacks – causes miscalc and goes nuclear

Orwig 16 [(Jessica, MS in science and tech journalism from Texas A&M, BS in astronomy and physics from Ohio State) “Russia says a growing problem in space could be enough to spark a war,” Insider,’ January 26, 2016, <https://www.businessinsider.com/russia-says-space-junk-could-spark-war-2016-1>] TDI

NASA has already warned that the large amount of space junk around our planet is growing beyond our control, but now a team of Russian scientists has cited another potentially unforeseen consequence of that debris: War. Scientists estimate that anywhere from 500,000 to 600,000 pieces of human-made space debris between 0.4 and 4 inches in size are currently orbiting the Earth and traveling at speeds over 17,000 miles per hour. If one of those pieces smashed into a military satellite it "may provoke political or even armed conflict between space-faring nations," Vitaly Adushkin, a researcher for the Institute of Geosphere Dynamics at the Russian Academy of Sciences, reported in a paper set to be published in the peer-reviewed journal Acta Astronautica, which is sponsored by the International Academy of Astronautics. Say, for example, that a satellite was destroyed or significantly damaged in orbit — something that a 4-inch hunk of space junk could easily do traveling at speeds of 17,500 miles per hour, Adushkin reported. (Even smaller pieces no bigger than size of a pea could cause enough damage to the satellite that it would no longer operate correctly, he notes.) It would be difficult for anyone to determine whether the event was accidental or deliberate. This lack of immediate proof could lead to false accusations, heated arguments and, eventually, war, according to Adushkin and his colleagues. A politically dangerous dilemma In the report, the Adushkin said that there have already been repeated "sudden failures" of military spacecraft in te last two decades that cannot be explained. "So, there are two possible explanations," he wrote. The first is "unregistered collisions with space objects." The second is "machinations" [deliberate action] of the space adversary. "This is a politically dangerous dilemma," he added. But these mysterious failures in the past aren't what concerns Adushkin most. It's a future threat of what experts call the cascade effect that has Adushkin and other scientists around the world extremely concerned. The Kessler Syndrome In 1978, American astrophysicist Donald Kessler predicted that the amount of space debris around Earth would begin to grow exponentially after the turn of the millennium. Kessler 's predictions rely on the fact that over time, space junk accumulates. We leave most of our defunct satellites in space, and when meteors and other man-made space debris slam into them, you get a cascade of debris. The cascade effect — also known as the Kessler Syndrome — refers to a critical point wherein the density of space junk grows so large that a single collision could set off a domino effect of increasingly more collisions. For Kessler, this is a problem because it would "create small debris faster than it can be removed," Kessler said last year. And this cloud of junk could eventually make missions to space too dangerous. For Adushkin, this would exacerbate the issue of identifying what, or who, could be behind broken satellites. The future So far, the US and Russian Space Surveillance Systems have catalogued 170,000 pieces of large space debris (between 4 and 8 inches wide) and are currently tracking them to prevent anymore dilemmas like the ones Adushkin and his colleagues cite in their paper. But it's not just the large objects that concern Adushkin, who reported that even small objects (less than 1/3 of an inch) could damage satellites to the point they can't function properly. Using mathematical models, Adushkin and his colleagues calculated what the situtation will be like in 200 years if we continue to leave satellites in space and make no effort to clean up the mess. They estimate we'll have: 1.5 times more fragments greater than 8 inches across 3.2 times more fragments between 4 and 8 inches across 13-20 times more smaller-sized fragments less than 4 inches across "The number of small-size, non-catalogued objects will grow exponentially in mutual collisions," the researchers reported.

### AC – Solvency

#### The aff solves orbital debris and decreases collision risks.

Budhiraia 20 [(Mili, LL.B. candidate 2022 at Faculty of Law, University of Delhi.) “The Menace of Space Debris,” August 30, 2020, https://www.jurist.org/commentary/2020/08/mili-budhiraja-space-debris-india/] TDI

For most of the time India has participated in the space industry, it has played with one hand firmly tied behind its back. But with the introduction of the Self-Reliant India Movement (Aatma Nirbhar Bharat Abhiyaan), private companies hold the baton along with the government organizations to operate in the entire range of space activities. The Indian space industry now has unrivaled possibilities in the sectorial dimensions that constitute the field of space research and exploration. This raises the question of how privatization in the new space economy has increased the threshold of accountability for state actors involved in the operations. As of now, there are 375 private companies all across the globe engaged in the space industry. The privatization of the space industry relies upon the premise that it would lead to the expansion of opportunities to utilize the space. When in the mid-twentieth century the concept of privatization rose to the fore, it was faced with a bitter backlash. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, popularly known as the ‘Outer Space Treaty’, was made when the concept of involving commercial entities into the multitude of space operations was not favored. The United States Communication Satellite Act of 1962 provided foundational support to the launch of communication satellites by commercial enterprises, thereby setting the stage for the entry of private players into the industry. But with increasing access to space operations and a growing level of satellite population, the problem of space debris, and the pollution caused due to the congestion of satellites, witnessed a simultaneous growth reaction. Space debris ranges from defunct spacecraft to paint flecks chipped off from wear and tear. A small debris particle of a mere 1 millimeter has the potential to cause catastrophic collisions. Privatization can act as an inducement in a hyper-dependent society banking upon satellite supported technology to launch more satellites into space. The estimate hints upon a possible 1100 satellites launched by the space industry each year by 2025. While satellites provide a broad, interdisciplinary use including human space exploration, meteorology, and climate change to name a few, the situation has the potential to significantly increase space traffic. It calls for a higher level of safety in the orbiting region from the floating debris, which can cause collisions. Astrophysicist Donald J. Kessler predicted that the debris in the Lower Earth Orbit (LEO) would reach a breaking point with an increase in satellite traffic and would start a collision chain reaction. This phenomenon is known as Kessler Syndrome. As a corollary to this phenomenon runs the concept of “Tragedy of the Commons” introduced by Garrett Hardins. The tragedy of commons occurs in a shared-resource system where independent operations motivated by self-interests deplete the shared-resource through their collective action. The increase in space traffic, which subsequently leads to an increase in space debris, can render LEO economically unviable for other participants. The legal framework dealing with the issue of space contamination is insufficient to provide any recourse. The Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2007) provides an international instrument of a persuasive nature and therefore, making it obligatory on the state parties is an onerous task. Article VI of the Outer Space Treaty imposes an international responsibility on the states, and Article VII renders a state party internationally liable to other states for any harm caused due to their operations. Though these provisions address the issues of responsibility in case of ruptures caused at an international level, they do not obligate states to take preventive actions or to remove the harmful agents from the outer space region. Moreover, Article IX of the Outer Space Treaty creates an obligation on the state parties to intimate with other members of the “potentially harmful activities”, but because the release of pollution is a recurrent phenomenon, the law cannot be put to good use. Article I of the Convention on International Liability for Damage Caused by Space Objects (Liability Convention) does not even cover environmental harm under the definition of damage. It exhibits the temperament of organizations on addressing the issues of environmental safety. The academic debate over the tackling of this issue has steered into the arena of taxation. A study has suggested that the problem of space debris can be controlled by levying “Orbit Tax”. The concept of Orbit Tax or Orbital Use Fees (OUF) stems from the Pigouvian Tax System proposed by the economist, Arthur Pigou. The Pigouvian tax was assessed on activities that adversely affect societal interests. The carbon tax which is assessed on the emission of greenhouse gasses illustrates the nature of this taxation system and the jurisprudence behind it. But as the question stands, is the employing of Orbit Tax an effective solution to curb the menace of space pollution? The answer cannot be in a binary nature. The implementation of the OUF requires global participation of the state actors who are involved in the space industry. Harmonious participation could only be ensured with the consensus reached among the state parties on the rate of taxation proposed, the criteria of assessing tax, etc. The Carbon Tax, a form of pollution tax, was implemented under the United Nations Framework Convention on Climate Change. It has witnessed significant participation and changes brought about in the municipal laws of many state members. But there has been a difference in the rate of taxation among the states which convolutes its implementation. Such disparities cannot be allowed to persist in the OUF model adopted for space debris taxation. Even if a presumption is accepted that Orbit Tax will be efficient in controlling the space debris release, the issue of the increased cost of operating satellites can result in a subsequent increase in the cost of providing satellite services. This can have an adverse impact on economically backward countries which are dependent on other state parties for launch and other satellite operations. Moreover, this does not provide an ultimate solution to eliminate the greater risk that debris causes. A better solution would be to motivate states to deploy efficient satellite infrastructure with a lower depletion rate. Instead of increasing the overall cost of a satellite through haphazard taxation measures, the satellite infrastructure shall be made more efficient. The goal should be of sustainable use of the resources. With the growing privatization of the Space Industry, the responsibility in outer space requires prompt actions. There is a need for international agreements of a binding nature to increase the threshold of accountability of member states to ensure a sustainable orbital domain. While increased participation of commercial enterprises is expounded as an economically growing feature of a country, the liability involved with the enlargement of the opportunity base cannot be side-lined. A legal framework has to be structured at both the international and national level to respond to the international responsibility laid down in Article VI of the Outer Space Treaty. Since the Outer Space Treaty is limited in its jurisdiction to state-sponsored activities, there is a need for an international instrument governing the operations of private players. The delay in employing environmental measures has significantly impacted the atmospheric make-up. The same temperament showcased for this issue could bring Kessler Syndrome to life.

#### A public-private partnership solves none of the aff – market dynamics and hiring competition mean the two sectors are zero sum.

Davenport 2/25 [(Christian, Reporter covering NASA and the space industry, Colby College, B.A., American Studies), “As private companies erode government’s hold on space travel, NASA looks to open a new frontier,” February 25, 2021, https://www.washingtonpost.com/technology/2021/02/25/nasa-space-future-private/] TDI

The four astronauts who will fly on a SpaceX mission by the end of the year will be a bunch of private citizens with no space experience. One’s a billionaire funding the mission; another is a health care provider. The third will be selected at random through a sweepstakes, and the last seat will go to the winner of a competition. In the new Space Age, you can buy a ticket to orbit — no need to have been a fighter pilot in the military or to compete against thousands of other overachievers for a coveted spot in NASA’s astronaut corps. In fact, for this mission, the first composed entirely of private citizens, NASA is little more than a bystander. It does not own or operate the rocket that will blast the astronauts into space or the capsule they will live in for the few days they are scheduled to circle Earth every 90 minutes. NASA has no say in selecting the astronauts, and it will not train or outfit them — that will all be done by Elon Musk’s SpaceX. The money to pay for the flight also will not come from NASA — or any other government account. The cost of the project is being borne by a billionaire, Jared Isaacman, who has set it up as a fundraiser for St. Jude’s Research Hospital and a promotional device for his business, Shift4Shop, which helps businesses set up websites and process payments. This is the new look of human space exploration as government’s long-held monopoly on space travel continues to erode, redefining not only who owns the vehicles that carry people to space, but also the very nature of what an astronaut is and who gets to be one. And it comes as NASA confronts some of the largest changes it has faced since it was founded in 1958 when the United States’ world standing was challenged by the Soviet Union’s surprise launch of the first Sputnik into orbit. Now it is NASA’s unrivaled primacy in human spaceflight that is under challenge. Thanks to NASA’s investments and guidance, the private space sector has grown tremendously — no entity more than SpaceX, which according to CNBC is now worth $74 billion. The commercial space industry is taking on ever more roles and responsibilities — flying not just cargo and supplies to the International Space Station, but even NASA’s astronauts there. The private sector will launch some of the major components of the space station NASA wants to build in orbit around the moon, and private companies are developing the spacecraft that will fly astronauts to and from the lunar surface. Space enthusiasts, including NASA, see enormous benefit in the shift — a new era of space exploration that will usher in a more capable and efficient space industry. But the changing dynamic also has left NASA, which for decades has set the pace for the American space project, with an uncertain role, a development NASA’s Safety Aerospace Safety Advisory Panel warns could have consequences for years to come. The growth of companies like SpaceX has "tremendous upside potential — and are accompanied by equally tremendous challenges for managing the risk of human space exploration,” it said in its annual report, released last month. “NASA leadership in human space exploration is still preeminent, but the agency’s role is evolving with critical implications for how risk and safety will be managed.” So far, NASA has done well “as it shifts from principally executing its programs and missions to commercially acquiring significant key elements and services,” it said. But as the agency continues to evolve, “NASA must make some strategically critical decisions, based on deliberate and thorough consideration, that are necessary because of their momentous consequences for the future of human space exploration and, in particular, for the management of the attendant risks.” In an interview, Steve Jurczyk, NASA’s acting administrator, said the agency is well aware of how its identity and role are changing, and he likened the agency’s role to how the U.S. government fostered the commercial aviation industry in the early 20th century. NASA’s predecessor, NACA, or the National Advisory Committee for Aeronautics, “did research, technology development to initially support defense … but also later on supporting a burgeoning commercial aircraft industry and aviation industry,” he said. “So that may be how we evolve, moving forward on the space side. We’re going to do the research and the technology development and be the enablers for continuing to support the commercial space sector.” NASA has not ceded all ground. It still leads major exploration and science programs that no company could match. Last week, for example, it landed a rover the size of a car on Mars, hitting a precise landing target after traveling nearly 300 million miles. Later this year, it is scheduled to launch the James Webb telescope, which is designed to look back in time to the origins of the universe. And it also recently snagged a sample of rocks and soil from an asteroid 200 million miles from Earth to return them to Earth for study. “NASA works," Rob Manning, the chief engineer at NASA’s Jet Propulsion Laboratory, said after the Perseverance landed safely on Mars. “When we put our arms together and our hands together and our brains together, we can succeed. This is what NASA does.” Those big, daring, push-the-envelope missions is where NASA’s future lies, agency and industry officials agree. Not in looking for financial gain, but blazing the trail and opening new frontiers, and then allowing private industry to take over in the way homesteaders expanded into the West. Within NASA, there is still some resistance to that paradigm shift. “NASA feels like that’s our domain,” said Phil McAlister, NASA’s director of commercial spaceflight. “And my response is, the solar system is a big place. We at NASA should always be doing the next thing, the thing where the profit motive is not as evident and where the barriers to entry are still too high for the private sector to really make a compelling business case.” Jan Worner, the outgoing general director of the European Space Agency, agrees. “I believe space agencies have to change,” he said in an interview. “If you are fixed permanently to the same thing that you did in the past, you will lose.” But NASA officials are concerned that much of the future workforce is going to be attracted to a growing number of commercial companies doing amazing things. There is Planet, for example, which is putting up constellations of small satellites that take an image of Earth every day. Or Relativity Space, which is 3-D printing entire rockets. Or Axiom Space, which is building a commercial space station. Or Astrobotic, which intends to land a spacecraft on the moon later this year. The question NASA faces, then, is an urgent one: “How do you maintain that NASA technical expertise?” Jurczyk said. The agency does not know. “It may mean people are hiring more midcareer from industry or having people come to NASA, then go to industry, and come back. Or a different model where maybe you’re not coming to NASA and staying for your 35-, 40-year career,” he said. “We’re still thinking through that.” The workforce predicament was not on NASA’s mind when it embarked on this road in 2006. That is when it awarded relatively small contracts to see whether the private sector could develop spacecraft capable of taking cargo to the International Space Station. At the time, SpaceX, which won an award, was largely unknown and on the verge of bankruptcy, with just one successful flight to orbit for its Falcon 1 rocket after three failures. Outside of what Musk once called “the weird rebels within NASA,” few thought the program would work. It was not taken seriously by the mainstream aerospace industry or even by NASA’s leadership. “Let’s just give these annoying commercial people enough money so that they can fail, and we can say, ‘That was dumb. We don’t have to do that again,'” Musk once told The Washington Post. But it did work. And now NASA is relying on the private sector not only to deliver supplies and science experiments to the surface of the moon, but also its most precious cargo — its astronauts — there. Turning over human spaceflight to the private sector was a line many thought NASA would never cross. But last year, SpaceX successfully flew two crewed missions to the space station, and Boeing, the other company with the human spaceflight contract, is hoping to fly its first later this year. NASA has been eager to build on that success and hire private-sector companies to build and operate the spacecraft that would take astronauts to and from the surface of the moon. And while NASA’s flagship rocket, the Space Launch System, would be used to fly astronauts to the moon and be the most powerful ever built, it has suffered all sorts of cost overruns and technical delays. A test of its engines that was supposed to last as long as eight minutes was cut short after just one because of a technical problem. And the redo of the test was recently postponed by NASA, which said it was looking into a problem with one of the valves. Recently, the NASA inspector general said the total cost of the rocket would reach $27 billion through 2025. That enormous cost has outraged critics of the space program, who have derided the effort as little more than a jobs program for select congressional districts and dubbed it the “Senate Launch System.” Recently, the Bloomberg editorial board called for the Biden administration to “scrap the Space Launch System,” asking, “Why is the U.S. government building a space rocket?” “No doubt, the era of government spacefaring had its glories,” the editorial read. “But space is now a $424 billion business, with U.S. companies at its forefront. The new administration should embrace this revolution — and bring the power of private enterprise to bear in crossing the next cosmic frontier.” Some high-level NASA officials, including former NASA Administrator Jim Bridenstine, have indicated that if the commercial sector can develop lower-cost alternatives, the space agency would have no choice but to consider those instead. NASA has already shifted one major mission from SLS — recently it announced that a commercial rocket, and not SLS, as Congress had mandated for years, would launch the Europa Clipper spacecraft that would study Jupiter’s moon. That alone would save NASA “over $1.5 billion compared to using an SLS rocket,” according to NASA’s fiscal year 2021 budget request. NASA has always relied on contractors to build its hardware — from the Apollo lunar module built by Grumman to the space shuttle, built largely by North American Rockwell. But NASA defined the precise requirements, took ownership of the spacecraft and operated them. That is not the case with many of its programs today. It works alongside the companies to validate their rockets and spacecraft and ensure they meet the agency’s safety standards. But the hardware and the launch procedures remain in private hands. The private astronaut mission, dubbed Inspiration4, marks the next iteration in this transition. Isaacman, the billionaire founder and chief executive of Shift4Shop, a payments technology company, paid an undisclosed sum for the SpaceX flight. Isaacman, an accomplished pilot, will occupy one of the four seats. Another will go to Hayley Arceneaux, a 29-year-old physician assistant at St. Jude Children’s Research Hospital. The third is to be raffled off as part of a fundraising effort for the hospital. And the fourth seat will go to the winner of a competition among entrepreneurs who use Shift4Shop’s platform. Isaacman has donated $100 million to St. Jude and hopes the fundraising effort will match that. “We will, of course, coordinate this with NASA,” Musk said on a call with reporters earlier this month to discuss the mission. “NASA has been briefed on this and is supportive.” But it will be SpaceX and the crew that will determine the flight parameters and training requirements, not NASA. “Wherever you want to go, we’ll take you there,” Musk said to Isaacman on the call. Meet the people paying $55 million each to fly to the space station That mission will be followed by a second flight made up entirely of civilians — three wealthy business executives, who are each paying $55 million, in addition to the commander, Michael Lopez-Alegria, a former NASA astronaut who now serves as a vice president at Axiom. Instead of spending a few days inside SpaceX’s Dragon spacecraft, which has about as much interior room as a large SUV, they will fly to the International Space Station. They will spend eight days there before flying back. Ultimately, Axiom’s goal is even bigger — to build a space station of its own. The ISS is getting old and will need to come down at some point. NASA has said that it would eventually get out of the space station business — and outsource that to the private sector as well. Axiom is one of the leading candidates to build the successor. If Axiom is successful, it could then proceed to its ultimate goal: charter missions of private citizens, flying on private rockets to a private space station with little to no involvement from NASA.

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