## NC

### FW

**The standard is maximizing expected wellbeing**

**First, pleasure and pain are intrinsically valuable. People consistently regard pleasure and pain as good reasons for action, despite the fact that pleasure doesn’t seem to be instrumentally valuable for anything.**

**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] SJDI

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.”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that if something is painful, we have a sufficient explanation of why it is bad. If we are onto something in our everyday reasoning about values, it seems that pleasure and pain are both places where we reach the end of the line in matters of value.

**Moreover, *only* pleasure and pain are intrinsically valuable. All other values can be explained with reference to pleasure; Occam’s razor requires us to treat these as instrumentally valuable.**

**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] SJDI

I think several things should be said in response to Moore’s challenge to hedonists. First, **I do not think the burden of proof lies on hedonists to explain why the additional values are not intrinsic values. If someone claims that X is intrinsically valuable, this is a substantive, positive claim, and it lies on him or her to explain why we should believe that X is in fact intrinsically valuable.** Possibly, this could be done through thought experiments analogous to those employed in the previous section. Second, **there is something peculiar about the list of additional intrinsic values** that counts in hedonism’s favor**: the listed values have a strong tendency to be well explained as things that help promote pleasure and avert pain.** To go through Frankena’s list, life and consciousness are necessary presuppositions for pleasure; activity, health, and strength bring about pleasure; and happiness, beatitude, and contentment are regarded by Frankena himself as “pleasures and satisfactions.” The same is arguably true of beauty, harmony, and “proportion in objects contemplated,” and also of affection, friendship, harmony, and proportion in life, experiences of achievement, adventure and novelty, self-expression, good reputation, honor and esteem. Other things on Frankena’s list, such as understanding, **wisdom, freedom, peace, and security, although they are perhaps not themselves pleasurable, are important means to achieve a happy life, and as such, they are things that hedonists would value highly.** **Morally good dispositions and virtues, cooperation, and just distribution of goods and evils, moreover, are things that, on a collective level, contribute a happy society, and thus the traits that would be promoted and cultivated if this were something sought after.** To a very large extent, the intrinsic values suggested by pluralists tend to be hedonic instrumental values. Indeed, pluralists’ suggested intrinsic values all point toward pleasure, for while the other values are reasonably explainable as a means toward pleasure, pleasure itself is not reasonably explainable as a means toward the other values. Some have noticed this. Moore himself, for example, writes that though his pluralistic theory of intrinsic value is opposed to hedonism, its application would, in practice, look very much like hedonism’s: “Hedonists,” he writes “do, in general, recommend a course of conduct which is very similar to that which I should recommend.”24 Ross writes that “[i]t is quite certain that by promoting virtue and knowledge we shall inevitably produce much more pleasant consciousness. These are, by general agreement, among the surest sources of happiness for their possessors.”25 Roger Crisp observes that “those goods cited by non-hedonists are goods we often, indeed usually, enjoy.”26 What Moore and Ross do not seem to notice is that their observations give rise to two reasons to reject pluralism and endorse hedonism. The first reason is that if **the suggested non-hedonic intrinsic values are potentially explainable by appeal to just pleasure and pain** (which, following my argument in the previous chapter, we should accept as intrinsically valuable and disvaluable), **then—by appeal to Occam’s razor—we have at least a pro tanto reason to resist the introduction of any further intrinsic values and disvalues. It is ontologically more costly to posit a plurality of intrinsic values and disvalues, so in case all values admit of explanation by reference to a single intrinsic value and a single intrinsic disvalue, we have reason to reject more complicated accounts.** **The fact that suggested non-hedonic intrinsic values tend to be hedonistic instrumental values does not, however, count in favor of hedonism solely in virtue of being most elegantly explained by hedonism; it also does so in virtue of creating an explanatory challenge for pluralists.** The challenge can be phrased as the following question: **If the non-hedonic values suggested by pluralists are truly intrinsic values in their own right, then why do they tend to point toward pleasure and away from pain?**27

**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)]  
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** nowknow — 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** indeedprofoundly **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.

**Reducing the risk of extinction is always priority number one.   
Bostrom 12** [Faculty of Philosophy and Oxford Martin School, University of Oxford.], Existential Risk Prevention as Global Priority.  Forthcoming book (Global Policy). MP. http://www.existenti...org/concept.pdfEven if we use the most conservative of these estimates, which entirely ignores the   possibility of space colonization and software minds, **we find that the expected loss of an existential   catastrophe is greater than the value of 10^16 human lives**.  **This implies that the expected value of   reducing existential risk by a mere one millionth of one percentage point is at least a hundred times the   value of a million human lives.**  The more technologically comprehensive estimate of 10  54 humanbrain-emulation subjective life-years (or 10  52  lives of ordinary length) makes the same point even   more starkly.  Even if we give this allegedly lower bound on the cumulative output potential of a   technologically mature civilization a mere 1% chance of being correct, we find that the expected   value of reducing existential risk by a mere one billionth of one billionth of one percentage point is worth   a hundred billion times as much as a billion human lives. **One might consequently argue that even the tiniest reduction of existential risk has an   expected value greater than that of the definite provision of any ordinary good, such as the direct   benefit of saving 1 billion lives.**  And, further, that the absolute value of the indirect effect of saving 1  billion lives on the total cumulative amount of existential riskâ€”positive or negativeâ€”is almost   certainly larger than the positive value of the direct benefit of such an action.

#### Extinction first –

#### 1 – Forecloses future improvement – we can never improve society because our impact is irreversible

#### 2 – Turns suffering – mass death causes suffering because people can’t get access to resources and basic necessities

#### 3 – Moral obligation – allowing people to die is unethical and should be prevented because it creates ethics towards other people

#### 4 – Objectivity – body count is the most objective way to calculate impacts because comparing suffering is unethical

#### 5 – Moral uncertainty – if we’re unsure about which interpretation of the world is true – we ought to preserve the world to keep debating about it

### Contention 1: Privatization

#### Privatization is key to space exploration and maximizing public sector efficiency.

Houser 17 [(Kristen, staff writer at Freethink, where she covers science and tech. Her written work has appeared in Business Insider, NBC News and Futurimsm), “Private Companies, Not Governments, Are Shaping the Future of Space Exploration,” June 12, 2017, <https://futurism.com/private-companies-not-governments-are-shaping-the-future-of-space-exploration>] TDI

**Private Companies**, Not Governments, Are **Shaping** the **Future of Space Exploration** The power is in our hands. / Off World/ Blue Origin/ NASA/ Space Race 2 0 SpaceX / Flickr Image by SpaceX / Flickr SPACE RACE 2.0 Sixty years ago, the Soviet Union launched the first artificial satellite into orbit. The event served as the starting pistol in what would come to be known as the Space Race, a competition between the U.S.S.R. and the United States for spaceflight supremacy. In the decades that followed, the first human reached space, a man walked on the Moon, and the first space stations were built. The U.S.S.R. and the U.S. were soon joined by other world powers in exploring the final frontier, and by the time the Soviet Union was dissolved in 1991, the contentious Space Race was something of a distant memory. The World’s Top Space Agencies [INFOGRAPHIC] Click to View Full Infographic In recent years, however, a new Space Race has taken shape—Space Race 2.0. Rather than powerful nations guided by presidents and premiers, however, the competitors in this race are tech startups and private businesses spearheaded by billionaire entrepreneurs. And while the current atmosphere is far less contentious than that of the first Space Race (save the odd tweet or two), the competition is just as fierce. A CROWDED FIELD SpaceX, Blue Origin, Bigelow Airspace, Virgin Galactic, Boeing, Lockheed Martin… Not only has the number of **private companies engaged in space exploration grown remarkably** in recent years, these **companies are** quickly **besting** their **government**-sponsored **competitors**. ADVERTISEMENT “We’re starting to see advances made by private entities that are more significant than any advances in the last three years that were made by the government,” Chris Lewicki, CEO and President of Planetary Resources, tells Futurism. Amazon CEO Jeff Bezos’s Blue Origin and Tesla CEO Elon Musk’s SpaceX are arguably the two companies that are setting the pace. In November 2015, the former completed the first successful vertical rocket landing after sending their New Shepard 100 kilometers (62 miles) into the air. SpaceX landed its own rocket a month later, only they did so with a craft twice as heavy as Blue Origin’s and traveled all the way into space first. A month after that, in January 2016, Bezos’s company became the first entity to re-launch and re-land a previously used rocket. SpaceX followed suit in 2017. “The government was never able to [build reusable rockets], but now, two private companies within the space of the same year have done that,” points out Lewicki. Not only are private companies already surpassing their government counterparts, several are poised to widen their lead in the coming months and years. ADVERTISEMENT If all goes according to plan, when SpaceX’s Falcon Heavy launches in September, it’ll take the title of the world’s most powerful rocket away from NASA’s Saturn V. Virgin Galactic is already selling tickets for what it expects to be the first private spaceflights, which will take place aboard the sleek VSS Unity. SpaceX plans to send space tourists to the Moon in 2018, and then in 2024, the company hopes to launch a system that will take people all the way to Mars…roughly 5-15 years before NASA expects to do the same. ALL ON THE SAME TEAM Private companies may be in the lead, but the finish line for this Space Race isn’t exactly clear. The first iteration was arguably “won” when Neil Armstrong took his first steps on the Moon, so does this sequel end when we establish the first Moon base? When a human walks on Mars? When we leave the solar system? Truthfully, the likelihood of humanity ever calling it a day on space exploration is slim to none. The universe is huge, with galaxy estimates in the trillions, so the goalpost will continue moving back (to bring another sport into the analogy). **Rather than** focusing on **competing in** what is ultimately **an unwinnable race, private and government-backed** space **agencies** can actually **benefit from collaboration** thanks to their inherent differences. “The way that SpaceX, Planetary Resources, or Virgin Galactic approaches space exploration is going to be very different from NASA or the Air Force,” explains Lewicki. **Private companies aren’t beholden to** the same **slow processes that** often **stall government projects,** and **they can secure** or reallocate **funding** much more **swiftly** if need be. However, unlike agencies like NASA, they do have shareholders to keep happy and a need to constantly pursue profitability. ADVERTISEMENT The two sectors, therefore, have a tremendous opportunity to help one another. Private companies can generate revenue through government contracts —for example, NASA has contracted Boeing to transport astronauts to the International Space Station (ISS), and SpaceX just closed a deal with the U.S. Air Force to launch its secretive space drone. This leaves the government agencies free to pursue the kind of forward-thinking, longer-term research that might not immediately generate revenue, but that can be later streamlined and improved upon in the private sector. Ultimately, Space Race 2.0 has no losers. The **breakthroughs** happening **in space exploration benefit us all**, and truly, a little friendly competition never hurt anyone (unless you count the egos bruised by those tweets).

#### Space exploration fails without private sector leadership.

WAMU 20 [(interviewing Ariel Ekblaw, founder and lead of MIT Media Lab’s Space Exploration Initiative and Charles Bolden, NASA administrator from 2009-2017) “How Private Companies Are Changing The Future Of Space Exploration,” February 6, 2020, https://wamu.org/story/20/02/06/how-private-companies-are-changing-the-future-of-space-exploration/] TDI

How Private Companies Are Changing The Future Of Space Exploration LISTEN SpaceX founder Elon Musk addresses the media alongside NASA Administrator Jim Bridenstine, and astronauts Doug Hurley and Bob Behnken, during a press conference announcing new developments of the Crew Dragon reusable spacecraft, at SpaceX headquarters in Hawthorne, California on October 10, 2019. (Philip Pacheco / AFP) Private companies like SpaceX are testing vehicles for manned space missions. We’ll peer out into the near future and next steps in human space exploration. Guests Ariel Ekblaw, founder and lead of MIT Media Lab’s Space Exploration Initiative. (@ariel\_ekblaw) Charles Bolden, NASA administrator from 2009-2017, and a former astronaut and Marine Corps general. (@cboldenjr) Interview Highlights American astronaut Christina Koch broke the record for the longest-ever space flight by a woman today. Where is human space exploration going next? Ariel Ekblaw: “It’s a huge milestone. Part of her story around the spacesuit, and the sizing of the spacesuits, and the all-female spacewalk is something that we pay a lot of attention to at our group at M.I.T. And then being able to be in space for that length of time provides an invaluable sense of knowledge of what is the human lived experience of space. “How might we better design for her comfort to delight her in space? To now, thanks to standing on the shoulders of groups like NASA and Charlie’s work, think about not just a survivalist mode for space exploration, but what are the artifacts, and the tools, and the experiences that we could design for Christine in the future? Given her experience of this 300-plus-day journey and stay to really delight her for her experience in space exploration. And in the future, scale that to space tourists and others besides astronauts.” On how close we are to regular space tourism Ariel Ekblaw: “I would say we’re both close — we’re dangerously close — and yet so far away. So companies like Blue Origin and Virgin Galactic are racing to be able to send some of the first space tourists into low Earth orbit on some of their crafts, in either this year, or upcoming years. With Axiom and the announcement from NASA about the first commercial space station to be attached to the International Space Station. “We’re beginning to build up that infrastructure that could support real space tourism. There are still, as I’m sure Charlie can also speak to, large unanswered questions about how do you prepare someone if not off the street — A space enthusiast — for the experience of space when they’re not necessarily going to have the same in-depth, extensive training as a NASA astronaut? How do we keep them safe? How do we handle mental health? How do we prepare them for both the excitement and the responsibility that they might have as a member of a crew in a resource constrained environment?” On whether people who aren’t trained as astronauts should be able to go into space Charles Bolden: “Yes, without a doubt. … They’ve got to have some training. But I would say it depends on what the flight is going to be. I haven’t had a chance to talk to Beth Moses from Virgin Galactic. But Beth would be — she’s not a normal person off the street, because she’s the astronaut training officer at Blue Origin. But Beth had an opportunity to fly, and she didn’t go through years of training. You know, I think there’s some fundamental things that you teach someone about mobility. And, ‘don’t touch that.’ And you let them go.” On whether it’s possible to go to Mars without commercial interest involved Ariel Ekblaw: “I think **it’s** **critical to have both**. As Charlie and Dava Newman — another colleague of mine — have shown: the path from moon to Mars is going to be a **public-private partnership path**. And **we need the capability that private brings** and the inspiration that NASA and that the governments can still bring to the task.” On what it’s like to go to space Charles Bolden: “It’s much more spectacular than the pictures portray. We have great cameras nowadays. They’re better and better than they ever were before, but they just cannot capture what the human eye sees. God’s camera is pretty awesome. The ability to play around with Newton’s law, the fact that, you know, because gravity is overcome by the speed at which you’re going around the planet allows us to seem like we’re floating. And that’s a lot of fun to get to play with. You know, a body at rest stays at rest, a body in motion stays in motion. And for every action, there’s an equal and opposite reaction. It makes all that stuff that you learned in middle school, if you learned it, or if you avoided it, it brings it to life for you. So that’s incredible.” From The Reading List Wall Street Journal: “Space Is Poised for Explosive Growth. Let’s Get It Right.” — “In the 19th century, urban planners wrangled the chaotic metropolises of Paris and New York into “planned cities,” turning warrens of streets into orderly grids, building sewage systems and transit lines, and allowing for new types of architecture, such as apartment buildings. Today, we face a similar inflection point in developing the nearest reaches of space. “The next decade is set to bring explosive commercial growth and more private industry players to low-earth orbit, the area spanning 100 to 1,240 miles above the planet’s surface. SpaceX has proposed a satellite-based internet, and Planet is growing its fleet of Earth-imaging satellites. NASA plans a transition towards commercial management of the international space station. Several startups are developing low-earth orbit advertisements—logos or other designs, visible in the night sky, made from tiny, reflective satellites. Entrepreneurs are making plans for space hotels. “Before we let rampant development go unchecked, we should consider how these efforts might conflict with or complement each other. We still have the chance to intentionally design humanity’s first ‘planned orbit.’” MIT Media Lab: “Democratizing Access to Space” — “The Space Exploration Initiative’s founding mission is to rigorously, vigorously build out the technologies of our sci-fi space future while keeping our innovations and team as open and accessible as possible. When we say we’re ‘democratizing access to space exploration,’ what do we mean? In the context of our blue sky goal — to realize an inclusive, impactful — we approach democratization in four core ways. We are: “1. Democratizing access by inviting and uniting new disciplines in our creative practice] “2. Democratizing access by designing space tools, products, and experiences for all of us, not just the pinnacle of human talent embodied by astronauts. “3. Democratizing access by developing hands-on, widely accessible opportunities to shape the technologies of our space future. “4. Democratizing access through the celebration of new narratives through which we can tell the story of Space Exploration, writ large.” The Verge: “This was the decade the commercial spaceflight industry leapt forward” — “Two years into the decade, on May 25th, 2012, a small teardrop-shaped capsule arrived at the International Space Station, packed with cargo and supplies for the crew living on board. Its resupply mission at the ISS wasn’t remarkable, but the vehicle itself was unique: it was a Dragon cargo capsule, owned and operated by a private company called SpaceX. “Before 2012, only vehicles operated by governments had ever visited the ISS. The Dragon was the first commercial vehicle to dock with the station. The milestone was a crowning achievement for the commercial industry, which has permanently altered the spaceflight sector over the last 10 years. “This decade, **the space industry has seen a shift in** the way it does **business**, with newer players looking to capitalize on different markets and more ambitious projects. **The result has been an explosion of growth** within the commercial sector. It’s allowing for easier access to space than ever before, with both positive and negative results. Such growth is providing the commercial space industry with lots of momentum coming into the 2020s, but it’s unclear if this pace is something that can be kept up.” Axios: “NASA’s murky commercial space future” — “NASA’s plans to create a robust economy in low-Earth orbit where private spaceflight companies can flourish could eventually leave the agency’s astronauts stranded on Earth with nowhere to go. “Why it matters: **NASA hopes to play a lead role in developing a private spaceflight economy, including private sector astronauts.** The agency sees this as a way to free it up to focus on farther afield goals like bringing humans back to the Moon and, eventually, to Mars.

#### Private companies are structurally advantaged, leading to more efficiency in production

**Tillman 19** [Nola Taylor Tillman, Graduate of Agnes Scott College and astronomy author , “Will Private Companies Beat NASA to the Moon?”, 07/31/2019, Space.com, <https://www.space.com/nasa-private-companies-moon-race.html>] /Triumph Debate

But private industry isn't solely focused on helping NASA make it to the moon. Companies like SpaceX and Blue Origin have stated their intentions to design their own lunar exploration programs. **Elon Musk's SpaceX is currently working on a 100-passenger vehicle called Starship, which the company envisions carrying people to the moon and Mars.** Starship will be lofted off Earth's surface by a huge rocket called Super Heavy. **SpaceX already has one Starship-Super Heavy passenger flight planned for 2023.** The company hopes to begin commercial operations of the pair as early as 2021, most likely with commercial satellite launches. Blue Origin, operated by Amazon founder Jeff Bezos, is working on a big lander called Blue Moon, which will deliver science instruments, lunar rovers and, eventually, astronauts to the lunar surface. Bezos sees many potential customers for Blue Moon other than NASA. "People are very excited about this capability to soft-land their cargo, their rovers, their science experiments on the surface of the moon in a precise way," Bezos said at the lander's unveiling in May 2019. "There is no capability to do that today." Then there's Florida-based company Moon Express, which is working to become the first private enterprise to reach the moon with robotic spacecraft systems. In 2016, it became the first company to receive U.S. government approval to send a robotic spacecraft to the lunar surface. "Our vision is really to expand Earth's economic and social sphere to include the moon," Alain Berinstain, Moon Express' vice president of global development, said last year at a lunar-science workshop at NASA's Ames Research Center in California. "We see the moon as the Earth's eighth continent to explore and to also mine for resources, like we have with every other continent on Earth." Pittsburgh-based Astrobotic planned to launch its Peregrine lander to the moon in 2019, but that date has since been since pushed back to 2020 or 2021. "We're really, at Astrobotic, trying to do this the right way, meaning that we're trying to be as technically rigorous as possible," Dan Hendrickson, vice president of business development at Astrobotic, said at a Washington Space Business Roundtable in February. "We're trying to be very upfront with the entire community about our current status." As with NASA, private industry has sufficient access to the technology to get to the moon, Whitman Cobb said. "They also have to demonstrate that their systems are fundamentally safe and reliable in order to attract paying customers — they are a business, after all," she said. **Private companies also tend to have a leaner leadership structure than NASA**'s 60-year-old legacy brings with it**. "NASA's bureaucracy has stagnated since the 1960s,"** Whitman Cobb said**. That makes it "more difficult for NASA to contract, make changes and adapt to new circumstances." On the other hand, private companies have demonstrated the ability to move through technology development at a rapid rate, incorporating design and technology changes "almost immediately," she said. That brings its own advantages.**

#### Space privatization uniquely spurs innovation-

**Daly 2020** [James Daly, Business & Technology Journalist, “How space exploration is now being fueled by business innovation”, 10/27/2020, IBM, <https://www.ibm.com/blogs/industries/ibm-space-tech-business-innovation-space-exploration/>] /Triumph Debate

**Camera phones. Wireless headsets. Scratch-resistant lens. CAT scans. The portable computer. They’re just a few of the enduring technologies the space program helped create, and which made their way into improving everyday life on earth.** **Now the business world is returning the favor. Innovations in the terrestrial corporate world—both in products and practices—are spurring the exploration of our solar system and beyond.** In recent years, technologies like edge computing, artificial intelligence, quantum computing, Internet of Things (IoT), digital twins and blockchain have transformed the business world with new efficiency and insight**. Soon they will have a similar effect on how we expand our knowledge of outer space, reducing costs while gathering and processing critical information with expanding speed and scale. “**A new space age is dawning, and the business world is helping drive it,” Naeem Altaf, the CTO for space industry tech at IBM, told Industrious. “One great thing about technology is that an innovation focused on one area or problem can sometimes impact another in wonderful ways.” Want to create your own out-of-this-world innovations? In addition to business process innovation, **technological advances by the private commercial sector are modernizing traditional and costly space practices by reusing rockets and building more efficient spacecraft, reducing per-launch costs**. **The global space industry is expected to generate revenue of $1.1 trillion or more in 2040, up from the current $350 billion**, according to a recent report by Morgan Stanley. “This entrepreneurial space age will change the course of human history,” Altaf said. **Arguably no innovation is having as cosmic an impact on space exploration as cloud and edge—so much so that Industrious is devoting an entire post to it later this week.** Check back Thursday to learn how the ability to perform expansive, high-speed processing remotely will push the bounds of what’s possible in our solar system and beyond. (Update: Read all about it here.) That’s just the beginning. Several other business tools are also making a significant impact. Digital twins, for instance, are having a big impact on both experimenting with new ideas and reducing costs. The twin concept uses a digital representation of a physical thing or system to stress test and reimagine various scenarios, with applications as diverse as quality management, security and product design. Digital twins are a key tool used in the servicing, assembly and manufacturing of both satellites and spacecraft. They improve the entire processes; digital twins can take data from IoT-embedded in-flight assets and then map that to new models and simulations, with AI helping analyze and iterate throughout the process. The European Union is also creating an ambitious digital twin of Earth that maps and analyzes massive amounts of geospatial data gleaned from satellites to simulate changes in the atmosphere. The EU model is expected to use machine learning techniques to provide more accurate predictions of climate change. “The world is a dynamic place–deeply connected, constantly evolving and always presenting humanity with new challenges,” Jim Whitehurst, IBM’s president, said in a post on IBM’s THINK blog. “Answers to global problems are grounded in two powerful forces: innovation and human ingenuity.” Quantum, and blockchain, mechanics Blockchain, with its shared, replicated, decentralized ledger system, also has an expanded role in space exploration optimization. Just as it eases cross-border commerce on Earth, blockchain could simplify or speed development efforts, offering “major potential to reduce costs, accelerate processes and transactions, provides provenance and transparency and ultimately shortens the time to market,” Altaf said. One place where blockchain can be useful is in optimizing resupply journeys to the International Space Station, also known as the ISS. This part of the aerospace industry is rapidly growing, particularly with the most recent innovations in launch facilities and payload vehicles from both the public and private sectors. One of the main concerns is ensuring that ISS resupply components align with regulatory requirements. Blockchain provides near real-time information that can improve the scheduling and auditing of each payload. Blockchain may even play a role in the management of space junk, creating a centralized and verifiable database of tens of thousands of pieces of manmade detritus circling the planet. Looking further out, quantum computing will solve complex-as-the-cosmos problems not only on Earth. In July, as part of its Mars 2020 effort, NASA launched the car-size Perseverance rover, which will search for ancient microbial life on the red planet. The rover has a drill to collect core samples of Martian rock and soil, then store them in sealed tubes for pickup by a future mission that would ferry them back to Earth for detailed analysis. In 2026 these samples will be retrieved for a trip back to earth. Quantum computing in future can play a critical role in such decision optimization scenarios. Carl Sagan, the popular astronomer, once noted, “Somewhere, something incredible is waiting to be known.” **The symbiotic relationship between business, space exploration and the business of space could reveal these incredible things even sooner. “The future of space exploration is unlimited,” Altaf said. “Now we hope to use our best technology from here on earth to push it even further forward.”**

### Two implications:

### Mining

#### Asteroid mining solves rare earth mineral shortages, resource conflicts, and toxic waste

Kevin MacWhorter 16, J.D. Candidate, William & Mary Law School, "Sustainable Mining: Incentivizing Asteroid Mining in the Name of Environmentalism", William & Mary Environmental Law and Policy Review, Vol 40, Issue 2, Article 11, https://scholarship.law.wm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1653&context=wmelpr

A. Rare Element Mining on Earth

In the next sixty years, scientists predict that certain elements crucial to modern industry such as platinum, zinc, copper, phosphorous, lead, gold, and indium could be exhausted on Earth. 12 Many of these have no synthetic alternative, unlike chemical elements such as oil or diamonds.13 Liquid-crystal display (LCD) televisions, cellphones, and laptops are among the various consumer technologies that use precious metals.14Further, green technologies including wind turbines, solar panels, and catalytic converters require these rare elements. 15 As demand rises for both types of technologies, and as reserves of rare metals fall, prices skyrocket.16 Demand for nonrenewable resources creates conflict, and consumerism in rich countries results in harsh labor treatment for poorer countries.17

In general, the mining industry is extremely destructive to Earth’s environment.18 In fact, depending on the method employed, mining can destroy entire ecosystems by polluting water sources and contributing to deforestation.19 It is by its nature an unsustainable practice, because it involves the extraction of a finite and non-renewable resource.20 Moreover, by extracting tiny amounts of metals from relatively large quantities of ore, the mining industry contributes the largest portion of solid wastes in the world.21 The Environmental Protection Agency (EPA) describes the industry as the source of more toxic and hazardous waste than any other industrial sector [in the United States], costing billions of dollars to address the public health and environmental threats to communities. 22 Poor regulations and oxymoronic corporate definitions of sustainability, however, make it unclear as to just how much waste the industry actually produces.23

Platinum provides an excellent case study of the issue, because it is an extremely rare and expensive metal—an ore expected to exist in vast quantities in asteroids.24 Further, production of platinum has increased sharply in the past sixty years in order to keep up with growing demand for use in new technologies.25 In fact, despite their high costs, platinum group metals are so useful that [one] of [four] industrial goods on Earth require them in production. 26 Scholars do not expect demand to slow any time soon.27 Among other technologies, industries use platinum in products such as catalytic converters, jewelry production, various catalysts for chemical processing, and hydrogen fuel cells.28 While there is no consensus on how far the Earth’s reserves of platinum will take humanity, many scientists agree that platinum ore reserves will deplete in a relatively short amount of time.29

With the rate of mining at an all-time high,30 it is increasingly clear that historical patterns of mineral resources and development cannot simply be assumed to continue unaltered into the future. 31 The platinum mining industry, however, has a strong incentive to increase its rate of extraction as profits grow with the rate of demand. Without any alternative, this destructive practice will continue into the future.32

So-called platinum-group metal (PGM) ores are mined through underground or open cut techniques.33 Due to these practices, all but a very small fraction of the mined platinum ore is disposed of as solid waste.34 The environmental consequences of platinum production are thus quite significant, but like the mining industry in general, the amount of waste is typically under-reported.35

While this is due to high production levels at the moment, those levels will only increase given the estimated future demand of platinum.36 In spite of the negative consequences, mining continues unabated because it is economically important to many areas.37 The future environmental costs provide a major challenge in creating a sustainable system. Relegating at least some mining companies to near-Earth asteroids would reduce the negative effects of future mining levels on Earth. The economic benefits of mining need not be sacrificed for the sake of the environment.38

#### Mineral shortages prevent the transition to clean energy needed to solve warming

Nafeez Ahmed 18, DPhil in international relations from the School of Global Studies at Sussex University, an investigative journalist and international security scholar, Dec 12 2018, "We Don't Mine Enough Rare Earth Metals to Replace Fossil Fuels With Renewable Energy", Vice, https://www.vice.com/en\_us/article/a3mavb/we-dont-mine-enough-rare-earth-metals-to-replace-fossil-fuels-with-renewable-energy

A new scientific study supported by the Dutch Ministry of Infrastructure warns that the renewable energy industry could be about to face a fundamental obstacle: shortages in the supply of rare metals.

To meet greenhouse gas emission reduction targets under the Paris Agreement, renewable energy production has to scale up fast. This means that global production of several rare earth minerals used in solar panels and wind turbines—especially neodymium, terbium, indium, dysprosium, and praseodymium—must grow twelvefold by 2050.

But according to the new study by Dutch energy systems company Metabolic, the “current global supply of several critical metals is insufficient to transition to a renewable energy system.”

The study focuses on demand for rare metals in the Netherlands and extrapolates this to develop a picture of how global trends are likely to develop.

“If the rest of the world would develop renewable electricity capacity at a comparable pace with the Netherlands, a considerable shortage would arise,” the study finds. This doesn’t include other applications of rare earth metals in other electronics industries (rare earth metals are widely used in smartphones, for example). “When other applications (such as electric vehicles) are also taken into consideration, the required amount of certain metals would further increase.”

Demand for rare metals is pitched to rise exponentially across the world, and not just due to renewables. Demand is most evident in “consumer electronics, military applications, and other technical equipment in industrial applications. The growth of the global middle class from 1 billion to 3 billion people will only further accelerate this growth.”

But the study did not account for those other industries. This means the actual problem could be far more intractable. In 2017, a study in Nature found that a range of minerals essential for smartphones, laptops, electric cars and even copper wiring could face supply shortages in coming decades.

#### **Climate change exacerbates all conflict- it’s the biggest existential threat to humanity.**

Sharp and Kennedy, 14 – is an associate professor on the faculty of the Near East South Asia Center for Strategic Studies (NESA). A former British Army Colonel he retired in 2006 and emigrated to the U.S. Since joining NESA in 2010, he has focused on Yemen and Lebanon, and also supported NESA events into Afghanistan, Turkey, Egypt, Israel, Palestine and Qatar. He is the faculty lead for NESA’s work supporting theUAE National Defense College through an ongoing Foreign Military Sales (FMS) case. He also directs the Network of Defense and Staff Colleges (NDSC) which aims to provide best practice support to regional professional military and security sector education development and reform. Prior to joining NESA, he served for 4 years as an assistant professor at the College of International Security Affairs (CISA) at National Defense University where he wrote and taught a Masters' Degree syllabus for a program concentration in Conflict Management of Stability Operations and also taught strategy, counterterrorism, counterinsurgency, and also created an International Homeland Defense Fellowship program. At CISA he also designed, wrote and taught courses supporting the State Department's Civilian Response Corps utilizing conflict management approaches. Bob served 25 years in the British Army and was personally decorated by Her Majesty the Queen twice. Aftergraduating from the Royal Military Academy, Sandhurst in 1981, he served in command and staff roles on operations in Northern Ireland, Kosovo, Gulf War 1, Afghanistan, and Cyprus. He has worked in policy and technical staff appointments in the UK Ministry of Defense and also UK Defense Intelligence plus several multi-national organizations including the Organization for Security and Cooperation in Europe (OSCE). In his later career, he specialized in intelligence. He is a 2004 distinguished graduate of the National War College and holds a masters degree in National Security Strategy from National Defense University, Washington, D.C. AND is a renewable energy and climate change specialist who has worked for the World Bank and the Spanish Electric Utility ENDESA on carbon policy and markets (Robert and Edward, 8-22, “Climate Change and Implications for National Security” http://www.internationalpolicydigest.org/2014/08/22/climate-change-implications-national-security/)djm

Our planet is 4.5 billion years old. If that whole time was to be reflected on a single one-year calendar then the dinosaurs died off sometime late in the afternoon of December 27th and modern humans emerged 200,000 years ago, or at around lunchtime on December 28th. Therefore, human life on earth is very recent. Sometime on December 28th humans made the first fires – wood fires – neutral in the carbon balance. Now reflect on those most recent 200,000 years again on a single one-year calendar and you might be surprised to learn that the industrial revolution began only a few hours ago during the middle of the afternoon on December 31st, 250 years ago, coinciding with the discovery of underground carbon fuels. Over the 250 years carbon fuels have enabled tremendous technological advances including a population growth from about 800 million then to 7.5 billion today and the consequent demand to extract even more carbon. This has occurred during a handful of generations, which is hardly noticeable on our imaginary one-year calendar. The release of this carbon – however – is changing our climate at such a rapid rate that it threatens our survival and presence on earth. It defies imagination that so much damage has been done in such a relatively short time. The implications of climate change are the single most significant threat to life on earth and, put simply, we are not doing enough to rectify the damage. This relatively very recent ability to change our climate is an inconvenient truth; the science is sound. We know of the complex set of interrelated national and global security risks that are a result of global warming and the velocity at which climate change is occurring. We worry it may already be too late. Climate change writ large has informed few, interested some, confused many, and polarized politics. It has already led to an increase in natural disasters including but not limited to droughts, storms, floods, fires etc. The year 2012 was among the 10 warmest years on record according to an American Meteorological Society (AMS) report. Research suggests that climate change is already affecting human displacement; reportedly 36 million people were displaced in 2008 alone because of sudden natural disasters. Figures for 2010 and 2011 paint a grimmer picture of people displaced because of rising sea levels, heat and storms. Climate change affects all natural systems. It impacts temperature and consequently it affects water and weather patterns. It contributes to desertification, deforestation and acidification of the oceans. Changes in weather patterns may mean droughts in one area and floods in another. Counter-intuitively, perhaps, sea levels rise but perennial river water supplies are reduced because glaciers are retreating. As glaciers and polar ice caps melt, there is an albedo effect, which is a double whammy of less temperature regulation because of less surface area of ice present. This means that less absorption occurs and also there is less reflection of the sun’s light. A potentially critical wild card could be runaway climate change due to the release of methane from melting tundra. Worldwide permafrost soils contain about 1,700 Giga Tons of carbon, which is about four times more than all the carbon released through human activity thus far. The planet has already adapted itself to dramatic climate change including a wide range of distinct geologic periods and multiple extinctions, and at a pace that it can be managed. It is human intervention that has accelerated the pace dramatically: An increased surface temperature, coupled with more severe weather and changes in water distribution will create uneven threats to our agricultural systems and will foster and support the spread of insect borne diseases like Malaria, Dengue and the West Nile virus. Rising sea levels will increasingly threaten our coastal population and infrastructure centers and with more than 3.5 billion people – half the planet – depending on the ocean for their primary source of food, ocean acidification may dangerously undercut critical natural food systems which would result in reduced rations. Climate change also carries significant inertia. Even if emissions were completely halted today, temperature increases would continue for some time. Thus the impact is not only to the environment, water, coastal homes, agriculture and fisheries as mentioned, but also would lead to conflict and thus impact national security. Resource wars are inevitable as countries respond, adapt and compete for the shrinking set of those available resources. These wars have arguably already started and will continue in the future because climate change will force countries to act for national survival; the so-called Climate Wars. As early as 2003 Greenpeace alluded to a report which it claimed was commissioned by the Pentagon titled: An Abrupt Climate Change Scenario and Its Implications for U.S. National Security. It painted a picture of a world in turmoil because global warming had accelerated. The scenario outlined was both abrupt and alarming. The report offered recommendations but backed away from declaring climate change an immediate problem, concluding that it would actually be more incremental and measured; as such it would be an irritant, not a shock for national security systems. In 2006 the Center for Naval Analyses (CNA) – Institute of Public Research – convened a board of 11 senior retired generals and admirals to assess National Security and the Threat to Climate Change. Their initial report was published in April 2007 and made no mention of the potential acceleration of climate change. The team found that climate change was a serious threat to national security and that it was: “most likely to happen in regions of the world that are already fertile ground for extremism.” The team made recommendations from their analysis of regional impacts which suggested the following. Europe would experience some fracturing because of border migration. Africa would need more stability and humanitarian operations provided by the United States. The Middle East would experience a “loss of food and water security (which) will increase pressure to emigrate across borders.” Asia would suffer from “threats to water and the spread of infectious disease.” In 2009 the CIA opened a Center on Climate Change and National Security to coordinate across the intelligence community and to focus policy. In May 2014, CNA again convened a Military Advisory Board but this time to assess National Security and the Accelerating Risk of Climate Change. The report concludes that climate change is no longer a future threat but occurring right now and the authors appeal to the security community, the entire government and the American people to not only build resilience against projected climate change impacts but to form agreements to stabilize climate change and also to integrate climate change across all strategy and planning. The calm of the 2007 report is replaced by a tone of anxiety concerning the future coupled with calls for public discourse and debate because “time and tide wait for no man.” The report notes a key distinction between resilience (mitigating the impact of climate change) and agreements (ways to stabilize climate change) and states that: Actions by the United States and the international community have been insufficient to adapt to the challenges associated with projected climate change. Strengthening resilience to climate impacts already locked into the system is critical, but this will reduce long-term risk only if improvements in resilience are accompanied by actionable agreements on ways to stabilize climate change. The 9/11 Report framed the terrorist attacks as less of a failure of intelligence than a failure of imagination. Greenpeace’s 2003 account of the Pentagon’s alleged report describes a coming climate Armageddon which to readers was unimaginable and hence the report was not really taken seriously. It described: A world thrown into turmoil by drought, floods, typhoons. Whole countries rendered uninhabitable. The capital of the Netherlands submerged. The borders of the U.S. and Australia patrolled by armies firing into waves of starving boat people desperate to find a new home. Fishing boats armed with cannon to drive off competitors. Demands for access to water and farmland backed up with nuclear weapons. The CNA and Greenpeace/Pentagon reports are both mirrored by similar analysis by the World Bank which highlighted not only the physical manifestations of climate change, but also the significant human impacts that threaten to unravel decades of economic development, which will ultimately foster conflict. Climate change is the quintessential “Tragedy of the Commons,” where the cumulative impact of many individual actions (carbon emission in this case) is not seen as linked to the marginal gains available to each individual action and not seen as cause and effect. It is simultaneously huge, yet amorphous and nearly invisible from day to day. It is occurring very fast in geologic time terms, but in human time it is (was) slow and incremental. Among environmental problems, it is uniquely global. With our planet and culture figuratively and literally honeycombed with a reliance on fossil fuels, we face systemic challenges in changing the reliance across multiple layers of consumption, investment patterns, and political decisions; it will be hard to fix!

### Hypersonics

#### New Mega-Constellations are key to hypersonic defense and early warning systems.

**Dangwal 21** [Ashish Dangwal, Ashish Dangwal holds a Master's degree in East-Asian studies and has a deep interest in Defence and Geopolitics related issues. He is interested in the impact of technology on foreign policy objectives as well as geopolitical operationality in the Indo-Pacific. Contact: ashishmichel@gmail.com, 12-9-2021, Latest Asian, Middle-East, EurAsian, Indian News, "US Plans To Build 'Constellation Of Satellites' To Identify, Detect & Track Russian, Chinese Hypersonic Missiles", <https://eurasiantimes.com/us-plans-to-build-constellation-of-satellites-russian-chinese-hypersonic-missiles/?amp> accessed on 12-22-2021] Adam

The Pentagon’s Space Development Agency may acquire new satellites as part of a global missile-tracking space sensor array aimed at providing a defense shield against Russian and Chinese ballistic and hypersonic missiles. Current missile defense systems lack the capability required to effectively track and destroy hypersonic weapons. Due to its speed and hyper-maneuverability, hypersonic weaponry is designed to outmaneuver current detection systems. The growing capabilities of China and Russia in space have sparked concerns in the United States about potential threats to US assets. The precision attack capabilities of the US military are predominantly dependent on satellite technology. Infrared satellites also provide crucial intelligence for early warning systems that trace and identify nuclear warheads. In the last few years, the United States’ prime focus has been shifted to securing these assets. According to a new proposal [released](https://sam.gov/opp/c5d54373342944998cb78e0efd37aeb4/view) on December 6, the Space Development Agency plans to buy 28 satellites for a constellation known as Tracking Layer Tranche 1, which is expected to aid in the detection, identification, and tracking of hypersonic weapons and other advanced missile threats. SDA plans to award contracts to multiple vendors to build a constellation of up to 28 satellites divided into four orbital planes at an altitude of about 1,200 kilometers above Earth. Current Developments The launch of these 28 spacecraft is expected to begin in late 2024. It would increase the number of missile-detection satellites in the Tracking Layer Tranche 0, a batch of eight satellites currently being built by L3Harris and SpaceX for launch in 2023. The tracking layer would be used as a worldwide network of eyes to establish a defense shield against the ballistic and hypersonic missiles from Russia and China. The data acquired by missile-tracking satellites would be transferred through optical links to the [Transport Layer](https://www.sda.mil/transport/), a communications satellite constellation that SDA is also developing. If a missile threat is detected, the location and trajectory data can be securely relayed over space and downlinked to military command centers. The Transport Layer, which is the backbone of National Defense Space Architecture (NDSA), is responsible for ground and marine targets, while the Tracking Layer–the Next-Generation Overhead Persistent Reconnaissance (Next-Gen OPIR) constellation by Lockheed Martin and Northrop Grumman [NOC]–is to establish effective targeting of advanced missiles.

#### Russian hyper sonics are faster than ever – squo defense can’t check.

**Bratersky 21** [Alexander Bratersky, Alexander Bratersky is the Russia correspondent at Defense News. He has covered U.S.-Russian relations, NATO and Middle Eastern affairs, and Russian policy in Syria. He previously worked at the Moscow Times and Izvestia as a political reporter, as well as RIA Novosti as a Washington correspondent. 3-15-2021, accessed on 3-31-2021, Defense News, "Two down, more to go? With hypersonic weapons already in the field, Russia looks to improve features", <https://www.defensenews.com/global/europe/2021/03/15/two-down-more-to-go-with-hypersonic-weapons-already-in-the-field-russia-looks-to-improve-features/>] Adam

MOSCOW — Hypersonic weapons are a top priority for the Russian government, a defense analyst with the state-run think tank IMEMO has told Defense News, and with two now fielded, the country is looking into further improving the technology. “The so-called hypersonic technology is essentially an evolutionary development. However, it provides new, combined abilities for missile weapons: increased speed and maneuverability, and improved accuracy,” Dmitry Stefanovich said. “I can’t imagine a person who is responsible for the decision-making in the country and who wouldn’t be interested in improving all those features.” By creating hypersonic technology that can overcome missile defense systems, Russia maintains “[strategic stability and strategic balance,](https://www.defensenews.com/news/your-military/2019/12/24/putin-says-russia-is-leading-world-in-hypersonic-weapons/)” President Vladimir Putin once told Russian news agency Tass in March 2020. For Russia, hypersonic technology is also a way to avoid a quantitative [arms race](https://www.defensenews.com/global/the-americas/2020/04/17/russia-shows-willingness-to-include-new-nuke-hypersonic-weapon-in-arms-control-pact/) like the Soviet Union went through during the Cold War, said Viktor Litovkin, a retired colonel and military analyst with Tass. “We have no money to get involved in a quantitative arms race. You need to have a little, but the highest quality, which will restrain the adversary,” he said. There are currently two hypersonic missiles with the Russian military: the Avangard and the Kinzhal. The former is a nuclear-capable missile reportedly able to fly faster than 20 times the speed of sound. The first Avangard infrastructure was set up in December 2019. The Kinzhal (or “Dagger” in English) is a nuclear-capable air-launched ballistic missile fielded in December 2017. Before entering the military’s inventory, it was tested with the MiG-31 fighter jet. Putin has said the weapon can exceed 10 times the speed of sound, but some missile experts have cast doubt on that capability. Russian media previously reported the Kinzhal physically resembles the 9M723 ballistic missile developed for the Iskander tactical missile system. “If it looks like a duck, swims like a duck and quacks like a duck, then it probably is a duck,” Stefanovich said of the similarity. Russia is also testing its [3M22 Zircon anti-ship hypersonic cruise missile](https://www.defensenews.com/global/europe/2020/10/07/russia-reports-successful-test-launch-of-hypersonic-missile/), expected to be installed on the modernized submarine-killing ship Marshal Shaposhnikov. The vessel is undergoing its owns tests. The head of Tactical Missiles Corporation JSC, Boris Obnosov, told Tass last month that the Zircon’s testing is going according to schedule. The first launch of Zircon from the nuclear-powered submarine Severodvinsk will take place in June, industry officials said, according to reports from Tass this month. If testing goes well, the Zircon will be delivered to the military in the first half of 2022. Obnosov has said hypersonic projects are among the top priorities for his company, adding that there are “several dozen” hypersonic efforts ongoing in partnership with the country’s several research and development institutes. He said a center dedicated to hypersonic technology efforts could be established to oversee the projects, without providing further information. Tactical Missiles Corporation is Russia’s leading developer of hypersonic technology, so it might also be behind a recently tested prototype of an air-to-surface hypersonic missile meant for the Su-57 fifth-generation fighter jet. However, the company did not respond to questions from Defense News regarding its hypersonic projects.

#### Hypersonics cause nuclear war

**Lamrani 18** [Omar Lamrani, Omar Lamrani is a reporter that focuses on air power, naval strategy, technology, logistics and military doctrine for a number of regions, including the Middle East and Asia. He studied international relations at Clark University and holds a master's degree from the Diplomatic Academy of Vienna, where his thesis centered on Chinese military doctrine and the balance of power in the Western Pacific. Mr. Lamrani previously worked as an intern with the U.N. Office on Drugs and Crime, where he was assigned to the Afghanistan desk. 2-20-2018, accessed on 12-17-2020, Stratfor, "An Arms Race Toward Global Instability", <https://worldview.stratfor.com/article/arms-race-toward-global-instability>] Adam

Further complicating matters are hypersonic missiles. The missiles' high speed — at least five times the speed of sound — facilitates their rapid use and boosts their rate of survival by making them difficult to intercept. In addition, some hypersonic weapons come equipped with a glide vehicle that extends their range, enabling forces to launch the weapons from beyond an enemy's reach. These factors offer militaries great incentive to incorporate hypersonic missiles into their arsenals. As more and more countries adopt hypersonic missiles, the weapons' offensive abilities may prove destabilizing. States may opt to strike first — perhaps with nuclear weapons — to take out an adversary's hypersonic missile caches before the enemy has a chance to use them. Losing Control While weapons technology is developing at a rapid clip, arms control treaties are deteriorating just as quickly. Key agreements between the United States and Russia were foundering well before Washington shifted its focus back to great power competition. The United States withdrew from the Anti-Ballistic Missile Treaty in 2002, and the critical Intermediate-Range Nuclear Forces (INF) Treaty is showing signs of considerable strain, which is bound to increase as Washington bolsters its defenses. Alarmed by the United States' growing investment in missile defense and super-fuze technology, Russia and China will try to enhance their offensive capabilities in kind. The resulting arms race would probably drive the last nail into the INF's coffin and perhaps even jeopardize the New Strategic Arms Reduction Treaty. Beijing, meanwhile, will strive to keep its competitive edge in hypersonic weapons development in an effort to get ahead of Washington's advancing missile defense capabilities. Though the countries will try to craft new arms control agreements to accommodate their changing world, the challenges of striking a deal among three great powers with disparate strengths will get in the way. Coupled with the fall of critical arms control regimes and the rise of disruptive weapons technology, the next great power competition could erode global stability. Tightening arms races and moribund arms control agreements will undermine the trust between the great global powers and discourage cooperation. Instead, more discord and conflict will erupt between the United States on one side and Russia and China on the other.

## Case

#### Tracking debris exists now and solves collisions.

**Mosher** **’19** [Dave; September 3rd; Journalist with more than a decade of experience reporting and writing stories about space, science, and technology; Business Insider, “Satellite collisions may trigger a space-junk disaster that could end human access to orbit. Here’s How,” <https://www.usafa.edu/app/uploads/Space_and_Defense_2_3.pdf>; GR]

The Kessler syndrome plays center-stage in the movie "Gravity," in which an accidental space collision endangers a crew aboard a large space station. But Gossner said that type of a runaway space-junk catastrophe is unlikely. "Right now I don't think we're close to that," he said. "I'm not saying we couldn't get there, and I'm not saying we don't need to be smart and manage the problem. But I don't see it ever becoming, anytime soon, an unmanageable problem." There is no current system to remove old satellites or sweep up bits of debris in order to prevent a Kessler event. Instead, space debris is monitored from Earth, and new rules require satellites in low-Earth orbit be deorbited after 25 years so they don't wind up adding more space junk. "Our current plan is to manage the problem and not let it get that far," Gossner said. "I don't think that we're even close to needing to actively remove stuff. There's lots of research being done on that, and maybe some day that will happen, but I think that — at this point, and in my humble opinion — an unnecessary expense." A major part of the effort to prevent a Kessler event is the Space Surveillance Network (SSN). The project, led by the US military, uses 30 different systems around the world to identify, track, and share information about objects in space. Many objects are tracked day and night via a networkof radar observatories around the globe. Optical telescopes on the ground also keep an eye out, but they aren't always run by the government. "The commercial sector is actually putting up lots and lots of telescopes," Gossner said. The government pays for their debris-tracking services. Gossner said one major debris-tracking company is called Exoanalytic. It uses about 150 small telescopes set up around the globe to detect, track, and report space debris to the SSN. Telescopes in space track debris, too. Far less is known about them because they're likely top-secret military satellites. Objects detected by the government and companies get added to a catalog of space debris and checked against the orbits of other known bits of space junk. New orbits are calculated with supercomputers to see if there's a chance of any collisions. Diana McKissock, a flight lead with the US Air Force's 18th Space Control Squadron, helps track space debris for the SSN. She said the surveillance network issues warnings to NASA, satellite companies, and other groups with spacecraft, based on two levels of emergency: basic and advanced. The SSN issues a basic emergency report to the public three days ahead of a 1-in-10,000 chance of a collision. It then provides multiple updates per day until the risk of a collision passes. To qualify for such reporting, a rogue object must come within a certain distance of another object. In low-Earth orbit, that distance must be less than 1 kilometer (0.62 mile); farther out in deep space, where the precision of orbits is less reliable, the distance is less than 5 kilometers (3.1 miles). Advanced emergency reports help satellite providers see possible collisions much more than three days ahead. "In 2017, we provided data for 308,984 events, of which only 655 were emergency-reportable," McKissock told Business Insider in an email. Of those, 579 events were in low-Earth orbit (where it's relatively crowded with satellites).

#### The debris propagation model is a process not an event---timeframe is decades and intervening actors check. Err neg -- this is Kessler, the guy who made that model.

Burns Interviewing Kessler **’**13 Corrinne Burns, interviewing Donald Kessler, who made up the concept. [Space junk apocalypse: just like Gravity? 11-15-2013, https://www.theguardian.com/science/blog/2013/nov/15/space-junk-apocalypse-gravity]//BPS

Now? Are we in trouble? Not yet. Kessler syndrome isn't an acute phenomenon, as depicted in the movie – it's a slow, decades-long process. "It'll happen throughout the next 100 years – we have time to deal with it," Kessler says. "The time between collisions will become shorter – it's around 10 years at the moment. In 20 years' time, the time between collisions could be reduced to five years." Fortunately, communications satellites are, in the main, situated high up in geosynchronous orbit (GEO), whereas the risk of collisions lies mainly in the much lower, and more crowded, low Earth orbit (LEO). But that doesn't mean we can relax. "We've got to get a handle on it – we need to prevent the cascade process from speeding up." And the only way to do that is, he says, to begin actively removing junk from space. Charlotte Bewick agrees. She's a mission concepts engineer with the German space technology company OHB System, with special expertise in space junk – specifically, how we can capture it and bring it back to Earth. While agreeing with Kessler that the movie scenario is exaggerated, she remains concerned. "Fragments of junk can naturally re-enter the atmosphere [and so be removed from orbit]. But we're at the stage where the rate of creation of new debris fragments is higher than the rate of natural removal. The orbits most at risk harbour important space assets – satellites for weather forecasting, oil spill and bush fire detection, and polar ice monitoring." Bewick highlights the case of Envisat, a defunct 8,000kg spacecraft circling Earth in an orbit that is very popular with space agencies and, hence, pretty crowded. "If Envisat collides with a piece of debris or a micrometeorite, the fragments could render the whole orbital region unusable." So can we get the junk down, I asked Massimiliano Vasile, part of the Mechanical & Aerospace Department at the University of Strathclyde and co-ordinator of the Stardust network. He told me defunct satellites in the high GEO region have, for some time, been shifted to higher "graveyard orbits" to keep them out of the way. But that's not an option for items in low Earth orbit. For this, he tells me, researchers are looking seriously into active debris removal – in-orbit capture techniques like harpooning, netting and tethering, the use of contactless systems like ion-beams or lasers, and even onboard robotics to position the junk away from high-risk orbital regions. As for middle Earth orbit – well, ideas are welcome, he says. We're in no immediate danger from Kessler syndrome – but it's not a problem that's going away. Despite Gravity's artistic license, Donald Kessler is pleased to see the phenomenon represented on the big screen. "It is very improbable that events would play out as they did in the film," he says. "But if it raises awareness, then that's great."

#### No miscalc from satellite disruptions or space dust -- empirically denied. Also takes out the Russia scenario---their ev casually asserts escalation while we have examples from after their card was written that disprove it.

Mazur 12 (Jonathan Mazur, Manager Engineering at Northrop Grumman, writing in Space & Defense, from the Eisenhower Center for Space and Defense Studies. Past U.S. Actions: Redlines in Space. Space & Defense, Volume 6, Number 1, Fall 2012. https://inss.ndu.edu/Portals/97/Space\_and\_Defense\_6\_1.pdf?ver=2018-09-06-135424-147)

U.S. Reactions To Foreign Disruption Of U.S. Capabilities In the 1970s, it was suspected that a U.S. maritime communications satellite was turned off by the Soviets when it was outside of the range of U.S. tracking stations.25 There does not appear to be any documented U.S. reaction, and I suspect there was none. In the mid-1990s, satellite hackers in Brazil began hijacking U.S. military communication satellite signals to broadcast their own information, though it took until 2009 for Brazil to crack down on the illegal activity with the support of the DoD.26 In 1998, a U.S.-German satellite known as ROSAT was rendered useless after it turned suddenly toward the sun. NASA investigators later determined the accident was possibly linked to a cyber-intrusion by Russia. The fallout? Though there was an ongoing criminal investigation as of 2008; NASA security officials have seemed determined to publicly minimize the seriousness of the threat.27 In 2003, a signal originating from Cuba—later determined to be coming from Iranian embassy property— was jamming a U.S. communications satellite that was transmitting Voice of America programming over Iran, which was publicly referred to as an “act of war” by a U.S. official. 28 Press reporting indicates the U.S. administration was [frozen]“paralyzed” about how to cope with the jamming that continued for at least a month, even after U.S. diplomatic protests to Cuba.29 In 2005, U.S. diplomats protested to the Libyan government after two international satellites were illegally jammed disrupting American diplomatic, military, and FBI communications.30 In 2006, press reporting indicates that China hit a U.S. spy satellite with a ground-based laser. This action was acknowledged by the then director of the NRO, though the DoD remained tight lipped about the incident.31 “We’re at a point where the technology’s out there, and the capability for people to do things to our satellites is there. I’m focused on it beyond any single event.” – Air Force Space Command Commander, General Chilton, 2006 32 In 2009, a U.S. commercial Iridium communications satellite—extensively used by the DoD—was accidently destroyed by a collision with a dead Russian satellite.33 The U.S. company, Iridium, was able to minimize any loss of service by implementing a network solution within a few days.34 As of early 2011, no legal action had been taken by the company either because it is not clear who was at fault or because it might be politically problematic for the United States, which is trying to enter into bi-lateral transparency and confidence-building measures (TCBM) with Russia regarding space activities.35 Since August of 2010, North Korea has been intermittently using GPS jamming equipment, which reportedly has been interfering with U.S. and South Korean military operations and civilian use south of the North Korean border.36 Reportedly, only South Korea and the United Nations International Telecommunications Union—at the request of South Korea—have issued letters to Pyongyang demanding the cessation of disruptive communications signals in South Korea.37 It appears that the only time the U.S. military has responded with force to a disruption in U.S. space capabilities was in 2003, a few days after the start of the Iraq war.38 According to U.S. officials, Iraq was using multiple GPS jammers—which supposedly did not affect military GPS functionality. However, the U.S. military bombed the jammers anyway after a diplomatic complaint to Russia.39 The use of military force against the GPS jamming threat was possibly because the United States was already intervening in Iraq, and the bombing probably would not have occurred if the United States was not at war.

Global food supply is highand resilient.

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Crop yieldshave increased(see Figure 3) and globalfood production, far from declining, has

actually increased in recent decades. Between 1990–92 and 2011–13, although global population

increased by 31%to 7.1 billion, availablefood supplies increasedby 44%.Consequently, the population

suffering from chronic hungerdeclinedby 173 milliondespitea population increaseof 1.7

billion.112 This occurred despitethe diversion of landand crops fromproduction of food

to the production of biofuels. According to one estimate, in 2008 such activities helped push

130–155 million people into absolute poverty, exacerbating hungerin this most marginal of

populations. This may in turn have led to 190,000 premature deaths worldwide in 2010 alone.113 Thus, ironically, a policy

purporting to reduce AGW in order to reduce future poverty and hunger only

magnified these problems in the present day.