ATTACHMENT 1

PROPOSED ACADEMIC RESEARCH TOPICS FOR USSPACECOM

1. Below is a list of proposed topics collected from across USSPACECOM directorates and key elements requiring original, specialized and deep academic research toward relevant unclassified as well as potential other real-world considerations outside the purview of the author, faculty and PME institution submitting the research. Each topic relates to one or more of the following USSPACECOM Commander's key tasks: understanding our competition, building the command to compete and win, maintaining key relationships, maintaining digital superiority, and integrating commercial and interagency organizations.

2. The USSPACECOM directorates and senior leadership created the following list of academic research topics and also prioritized the 'top five' of this list by directorate. The prioritization status should not be interpreted as a value or popularity indicator. Rather, students interested in a topic can use the directorate interest/indication as one factor of several in determining topic selection. A topic with multiple directorates interested in that research also may indicate competing, paradoxical or unrelated interests based on the context and characterization of each directorate's needs and interests. A topic with no directorate 'top five' prioritization may actually be more impactful than one with stated directorate interest in that potentially, all directorates view that topic in a larger concentration in a #6-10 status, or the reader may provide an entirely unanticipated (even unprecedented) position on a topic that suddenly elevates it to a much higher prioritization upon submission. The topics for this project are:

1. Emergent Space Conflict Theory and Policy. How should USSPACECOM prepare to fight a future space war? What changes are needed in existing Department of Defense policy, strategy, doctrine, theories and organizational form/function?

2. The Trinity of Multi-Domain Conflict. Explore the idea that future conflict may center on space, cyberspace, and special operations forces. How would this function? What changes are needed for U.S. and allied security organizations to shift to this context?

3. Space in the Age of Digital Superiority. USSCYBERCOM, was the first Combatant Command that is entirely digital. Is USSPACECOM the first geographic oriented Combatant Command that also must fight exclusively in a digital context? If so, are there unique considerations and functions for USSPACECOM that USSCYBERCOM does not require?

4. Command and Control. Historically, the AF Air Operations Center has been the primary program of record for AF C2 systems development and fielding. Working with JADOC, JTT, and other joint C2 software, these software packages have responded to the traditional requirements process. The Joint Force has pursued the same requirements to fielding approach and results have not resulted in improved multi-domain C2.

5. Strategic Design of USSPACECOM. While well on its way to being stood up, the fluidity of organizational design of USSPACECOM offers a once-in-a-century opportunity. This study

would examine if the U.S. is making the most of this unique era and would propose organizational changes both subtle and radical to improve effectiveness of space warfighting.

6. Adapting to Advance Missile Warning Threats. Due to the changes and adaptability of new adversary threats, our detection, tracking and display systems/capabilities (satellites, radars and common operating picture or COP) must be able to address our adversaries' abilities.

7. First Strike Instability in Space and Escalation Control. Because of the unstable nature of 1st strike instability, there is a pressure to escalate to kinetic activity in the space domain during the competition-conflict transition. Current escalation frameworks do not account for the space domain instability in the broader geopolitical context.

8. The Role of Novel Orbits in Generation-after-Next Generation Warfighting. U.S. military systems have been largely confined to operating in low Earth and geosynchronous orbits. This study would examine how a range of alternative orbits (including cis lunar and heliocentric) might impact providing space services and space control both positively and negatively.

9. Hostile Intent and Hostile Act. How lessons from other domains can inform determining hostile intent and hostile act for space engagements. Examine how hostile intent is determined for other domains and what systems and processes might be changed to improve the accuracy and timeliness of determining hostile intent for space operations.

10. Mega-Constellations. The use of mega-constellations comprised of small satellites is on the rise, both commercially and internationally. These constellations impact the space area of operations and challenge our ability to maintain space domain awareness.

11. Proliferation of Commercial, Civil, and Military Space Systems. Understand what it would mean to have 10,000, 100,000, or 1,000,000 satellites in orbit from a military perspective. Include aspects such as fog of war (how does SDA change), command and control, autonomy, and impact to terrestrial services.

12. Responsive Space Architectural Changes to Improve Cost-Benefit. Examine how responsive space elements of an architecture might favorably compare with other resiliency options, particularly for augmentation and reconstitution. This study would compare responsive augmentation and reconstitution options to the baseline and more traditional alternatives.

13. The Road to Norms of Behavior for Space. How is space the same/different and can we get to stability faster than other domains? Examine how norms of behavior developed in other domains and how this information might aid in developing norms for space.

14. Alternative Futures for the Extraterrestrial Battlespace. Examine the future of space warfare through a lens of technology, policy, and evolving space applications. Alternative futures (e.g. mining the asteroids/moon, a competitor passes us, avenues of technological surprise, etc.) would be examined to see where the U.S. would find the most military advantage and disadvantages.

15. The Role of Space in Strategic Deterrence. The role of space in deterrence is emerging as a critical topic in the future development of a deterrence strategy for the United States. Examine the past, present, and future role of space in strategic deterrence and if space can play a greater or unique role in strategic deterrence, increasing stability and security for the U.S. and the world.

16. Terrestrial Response Options for Space Aggressions. Determine how to deter space aggressions using terrestrial actions. It is typically difficult to apply DIME deterrence actions to transgressions in the space domain.

17. Space Deterrence Theory. Examine the similarities and differences for how aggression is deterred in other domains as compared with space. Key differences might be that there is rarely a directly loss of life and greater difficulty collecting international interest in deterring space aggression.

18. The Global Proliferation of PNT. Alternatives to GPS are proliferating, offering the U.S. and its adversaries new opportunities and challenges in the PNT battlespace of the future. This study would plumb the depths of how this proliferation of PNT affects the future of warfare.

19. Replacing GPS for U.S. PNT Requirements. Study alternatives to replacing GPS both technologically, sociologically, commercially, and militarily. Even if technology does not exist, extrapolate how "if" statements might impact dimensions of the PNT user community, particularly the military community.

20. Informational Silos from Classified Programs. The rate of technological convergence and information availability has transformed commercial industry. U.S. reliance on classification to provide strategic advantage has always been seen as a strength, but with rate of change increasing, it is possible that the silo-ing of information may prove a strategic disadvantage. This study will seek to expose disadvantages to slowing information flow caused by classification or other barriers.

21. Information Opportunities and Vulnerabilities for the Space Enterprise. How the U.S. Space Enterprise (terrestrial and in-space) is vulnerable to open source, crowd sourced, and easily observable information.

22. Critical Asset Analysis Tool. Build a module for the USSPACECOM Critical infrastructure Decision Support System (UCIDS) for unclassified and classified information using standard Microsoft Office Programs to enable USSPACECOM personnel to load, view, edit, print reports etc. to manage all USSPACECOM critical assets. Tool needs to be able to identify/show shortfalls and deficiencies for Critical Mission Assets.

23. Chess in Space. Application and Evolution of Military Strategies to the Space and Joint Fight: Develop an appendix to the "Art of War" for space. Student may consider earlier published military research on 'Chess versus Go: American and Chinese defense philosophical differences' and other metaphoric, game theory, cultural and institutional differences as well.

24. Operationalizing space deterrence: what is an effective strategy for deterrence? How should the US enable integrated deterrence in the space domain? How should space deterrence properly nest within national objectives, policy, and deterrence as a whole? What considerations are senior leaders not considering that would complement current trajectories?

25. Enabling commercial integration: how should the DoD adapt its business model to the rapid life cycle of innovation and emerging technology? Balancing capability, time, and control, how can the DoD mitigate bureaucratic impediments that delay modernization plans? How is space different from the terrestrial domains regarding commercial integration? How does the DoD go beyond material solutions in partnerships with the private sector to effectively leverage and strengthen the National Security Innovation Base?

26. Civil Enterprise Assumption of Space Situational Awareness: The transition for Space Situational Awareness to be monitored by civil entities is taking too long. What impact does that have on DOD members in cost and manpower? What are the major hurdles institutionally, organizationally, legally and internationally? What are the consequences if this takes too long for USSPACECOM, the DoD and other stakeholders? How might this problem be resolved or a faster solution implemented outside of existing or traditional approaches?

27. Protecting non-traditional space assets: Space elevators are stationary structures stretching to LEO altitudes that will be able to launch satellites. What are the complexities of protecting these assets? Is this a US Space Command responsibility or a Regional Combatant Command responsibility? Both? How should they be protected?

28. What are the pros and cons of commercialization of space from a military perspective? Starlink provided critical support to Ukraine but was later restricted by the company. Commercial imagery provides timeliness and high-resolution imagery, but it is expensive. DoD use of commercial imagery ebbs and flows, to the great frustration of the commercial SATCOM industry. *Can* DoD rely on commercial capabilities? *Should* DoD rely on commercial space? If so, which capabilities or services? If not, why not? Does DoD need new standards or procedures for the use of commercial space such as, but not limited to, mandatory radiation hardening? Development of turn-key ground systems? Spare satellites or lift? How do we manage or leverage escalation by using commercial capacity during conflict?

29. Who is the pacing threat and why: Both DoD and US Space Command selected China as the pacing threat. China is the technically superior adversary, but Russia is at war with a western partner. Did we get this right? Why or why not? What organizational forcing functions come with each choice and why? Has US Space Command addressed these requirements? What are the risks of each choice, and how can US Space Command and DoD mitigate these risks?

30. Arctic conflict and space: What would conflict in the arctic look like from a space perspective? What should DoD, civil authorities, and US Space Command do to prepare for conflict in the arctic? Northern latitudes provide advantages and disadvantages for space operations. How do we exploit the advantages and mitigate the disadvantages of latitude, extreme weather, and limited infrastructure? What alternatives to space should DoD look at for arctic operations?

31. Non-state actors vs. the United States, et al: In the spirit of the British East India Company and the Dutch West India Company, how should the US combat a hostile non-state actor in space? What would the threat look like? What might trigger a conflict? Would it necessarily be US vs. the company? What military and non-military options exist?

32. Quantum Theory and Warfare for the Space Domain: Quantum computing, encryption, and other more exotic possible applications are rapidly moving from the hypothetical into the theoretical and small-scale validation on a wide range of quantum applications in defense and national security. Space will play an important role in future quantum applications. How should USSPACECOM and the Department of Defense prepare changes in strategy, doctrine, operations, procurement, and other areas for how quantum will transform future conflict environments?

33. Human-Machine Teaming, AI in Sophisticated Narrow and (Theoretical) General Configurations for Space Applications: AI is a profound and disruptive field impacting virtually all aspects of societies. The accelerated yet still ill-defined future for human-machine relationships, teaming in security applications, and the long-term strategic, ethical, legal, and moral impacts of sophisticated AI (narrow, but potentially even general) posit new questions for the space domain. How does space present particular challenges with respect to AI and human security activities?

34. Autonomous Weapon Systems (AWS) in the Space Domain: AWS in the space domain presents new and challenging problems for how USSPACECOM, commercial enterprises, and other actors may seek to safeguard or defend space activities, commerce, and societies using ever-increasingly sophisticated AI and human-machine teams. The space domain is unique in the vast scale and celestial conditions that differ from terrestrial contexts. How will AWS employment by friendly, adversarial, and commercial entities occur in space, and how should USSPACECOM implement new designs now to prepare for these considerations?

35. Radical Space Technology: Considering the Space Elevator and How it Might Impact Future Security Contexts in Space: The space elevator has been prophesized for decades, yet despite most of the components for such a device now being demonstrated as theoretically viable in small-scale and simulations, no major government or investment group have committed fully to building one. China, Japan, and US private industry have declared intents, and new advances in nano-carbon and other technologies suggest a space elevator could be created in the coming decades. How would such a device impact society, and how would USSPACECOM cooperate in Joint and partnered configurations to secure and protect such a system? What would be the new authorities, changes in CCMD roles/responsibilities, and what might be broad security considerations for such a radical, disruptive development be?

36. The Future of Space Medicine in the DoD: With the stand-up of USSF and with USSPACECOM as the DoD Manager for Human Space Flight Support, the future of Space Medicine will significantly impact the DoD. How might the DoD further establish medical education and training to ensure medical professionals are prepared to support these missions? If

the future includes DoD astronauts, should training and medical review be the responsibility of NASA or the DoD?

37. Space Debris as a National Security Issue: ASATs are devastating weapons with the capability to destroy a satellite and create large debris clouds. Mega-constellations rob ASATs of their first order effect but what can the US do to solve the second order effects of debris clouds? Specifically, what policies and technologies need to be pursued to make active debris removal missions a viable capability that deters our enemies through denial?

38. Building a Space Alliance: How can the U.S. DoD Space Enterprise better integrate allies and partners into space organizations, training, equipping and operations by design, that is, incorporating allies and partners in U.S. concepts and plans for executing space operations from the beginning rather than at later stages? Focus on key allies (FVEYs+): UK, CAN, AUS, GE, DR, JP, and actions the U.S. can take in the next 2-5 years.