

## Suggested Prompts for Problem Statements to Support Idea Development

The following prompts are provided to assist in guiding problem statement development for idea presentation at the Air Force Science and Technology Workshop hosted by USF. You will note that many of these prompts span multiple workshop themes. Some of the prompts are similar; at the same time, this is by no means an exhaustive list. Feel free to use these or development your own theme-based problem statements.

### Air, Space and Cyberspace Superiority:

#### “Freedom from Attack and Freedom to Attack”

- What technologies are required to penetrate/defeat future both traditional and emerging air defense systems
- How do you maintain and/or reconstitute capability in event of attack against U.S. space assets across the variety of orbits the inhabit and services they provide?
- How do you model space debris and mitigate potential impact of space debris?
- How do you mitigate/detect counterfeit electronics?
- What novel means would provide effective attribution of cyber adversaries, today and in the future, for the purposes of determining lawful defensive courses of action? Types of attribution might include geolocation, country of attack origin, code/malware authorship, stylometry, biometrics, personal identity of attacker, and so on. Can we quantify our trust that the attribution is not spoofed?
- In possible future cyber battlespaces, what actions would you take to establish cyber deterrence? Consider that there won't be a one-size-fits-all strategy, rather an ensemble of strategies that need to be employed in parallel against Tier I-VI threat actors (as defined by the 2013 Defense Science Board (DSB) report on “Resilient Military Systems and the Advanced Cyber Threat”).
- What new applications of autonomy, machine learning, game theory, or artificial intelligence might be employed to enhance cyber situation awareness, course-of-action development, and prediction of effects in real time to accelerate the Air Force's Observe-Orient-Decide-Act loop for active defense?
- How can autonomy, machine learning, game theory, or artificial intelligence be employed as force multipliers to reliably and predictably scale defensive and deterrence operations by a factor of 100x?
- How can distributed systems cooperate to detect and adapt to threats? How can Byzantine failures (where compromised systems lie inconsistently about their state) be mitigated in heterogeneous systems-of-systems?
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### Global Integrated Intelligence, Surveillance, and Reconnaissance (ISR)

#### “Global Eyes and Ears on Adversaries”

- How can we better leverage open source information networks for pattern of life development
- What technologies could be used to defeat adversary attempts to hide and/or ensure target Identification across physical and virtual domains?
- What technologies can help achieve the military consumer desire for omnipresent ISR collection as well as processing, exploitation, and dissemination?

- What does USAF need to sense/surveil/interpret in 2030 that isn't addressed by technology today? (Case in point: it's very hard to distinguish drones from ground clutter and birds via radar)
  - o How would USAF sense/surveil/interpret those things?
  - o How would USAF neutralize threats thus sensed?
- How do you fuse information across air, space, and cyber while leveraging land and maritime command and control and ISR capabilities?

## Rapid Global Mobility

### “Delivery on Demand”

- What technologies enable the delivery of cargo/human payload anywhere in the world an order of magnitude faster than current capabilities?
- Aviation fuel is one of the most expensive non-human resource in the Air Force. How do you reduce the cost of this resource
- How do we decrease manual documentation, increased data accuracy and usability?
- How do we get rapid access to geo-referenced imagery and assets of global operating locations to support all aspects of operational planning and analyses?
- How do we maintain logistics operations in cyber contested-environments that degrade or compromise logistics information systems?
- How do we manufacture technologies that enable affordable and rapid fielding of larger quantities of capability?
- Is there a better way to determine what I need-where-when?
- Do I have the most efficient equipment/system to deliver materials anywhere in the world anytime?
- Can I predict vehicle availability or know probability of success/failure for delivery systems?
- Is there examples in nature to emulate to create more efficient vehicles? Formation flight or morphing wings or structural layouts?
- Are there new technologies that can exploit rapid repair or aircraft modification for expedited delivery? Can delivery systems be transformed between transportation modes?
- What threats to the free motion of logistics might face USAF in 2030? What if air superiority is contested everywhere?
  - o How does USAF move personnel and material in such an environment?
  - o What if USAF is faced with an opponent who has comparable ability to project force as USAF? "Any Target, Any Time"
- How could self-healing materials impact logistics, readiness, sustainment, etc.?
- For aeromedical evacuation/patient care
  - o Can you provide continuous, physiological monitoring of patients and airmen in GPS, Wi-Fi denied environments?
  - o Can you provide autonomous patient or airmen pick-up in remote locations?
  - o Can you decrease the weight/fuel consumption needed for picking up personnel in remote environments through miniature electronics/sensors and optimized fuel?
  - o Blood delivery to remote locations (or possibly blood alternatives?)
  - o Oxygen supplies and how much is required (or how can you generate it?)
  - o In-transit visibility of people/patients.
  - o Getting equipment back to where needed, as patients are evacuated, a lot of supplies flow back towards Germany/U.S. - how do we get them back to deployed locations in the most efficient manner?

- Medical supplies delivered by drone (reduce fuel).

### Global Precision Strike

#### “Any Target, Any Time”

- In the event of loss of GPS, what are alternatives/backups that provide precision, navigation and timing necessary for target prosecution?
- What technologies provide non-lethal / non-destructive target neutralization
- How do you reduce collateral damage to zero?
- What new target classes (beyond combatants and the infrastructure that supports them) might need to be considered for 2030?
  - How would USAF find/acquire such targets?
  - What weaponry might be required for a strike on new classes of targets?

### Command and Control

#### “Right Info, Right Person, Right Time”

- How do you identify and disregard degraded/deceptive/false information in order to plan / execute mission
- How do you compress the Observe Orient Decide Act cycle in real time?
- How do you build secure networks that permit the transmission of massive amounts of data to users in an austere environment?
- How would you use “Blockchain” technologies (not cryptocurrencies) to secure AF systems more effectively or more efficiently than current methods?
- How can the AF improve the security of its hardware and software supply chain from foreign and criminal threat actors? Consider that the vast majority of AF information technology is commercially or even foreign procured. How might the AF leverage or partner with industry to provide solutions that are mutually beneficial and cost-effective?
- How do we accurately/securely access and use synthesized logistics information globally in a near real-time Common Operating Picture to enable timely decision making?
- How do we leverage modeling and simulation and predictive analysis tools through timely, high-quality intelligent information at strategic, operational, and tactical levels, when the Air Force has over 900 business systems and even more operating systems?
- How can we get computationally useful contractual artifacts/ models be delivered contractually and that can survive; be agnostic to the rapid technology changes; plus be forward compatible/useful years after delivery?
- How would we develop Stress/Aero/Performance/etc models, using novel ways that reduce the heavy computation needs of today?
- How do we change the trend in aerospace/defense industry where our aircraft/engine mechanics/technicians have been replaced by computer scientists/engineers - changing our ratio from 10 Mech/Techs:1 Eng/Sci in 1990's, to today 100-1000 + Eng/Sci: 1 Mech? How do we reduce the complexity of coding/programming our models to and push the requirement to a technician level?
- In a contested internet environment and electromagnetic spectrum environment, how do we assure communications?
  - How might our existing communication techniques be contested/compromised in 2030?
  - How do we assure that received commands are actually from our commanders and not injected into our communication stream?

- How can AF take advantage of 5G networks?

### Enhancing the Power of Airmen

- Enhance training in environment with reduced resources (student time, available hardware, limited instructors and locations)—[*gets at virtual reality, networked, AI-assisted trainers*]
  - How do you enhance, expand and optimize the cognitive capabilities of individuals/small crews while ensuring critical decisions are made by humans
  - Physiological and psychological wellbeing and enhancement to ensure optimum performance in extreme, stressful environments
  - How do we streamline certification of autonomous operations? What certification is required?
  - How do we keep airmen performing well when new types of attacks are being leveled against them? What new types of attacks might there be? Laser dazzling? Sonic attacks? Chemical weaponry?
  - How can wearable electronics enhance an Airman's performance?
  - How do you divide tasks among humans and machines?
  - How do you measure effectiveness of human-machine teams?
  - What are the implications of synthetic biology on an Airman's performance?
  - Can you decrease the cognitive and psychological workload of military members through automation of manual tasks, and clinical decision support through telehealth/telementoring?
  - Can you provide enhanced visualization of one's environment such as through terrain scanning, automatic scanning of airframes for patients/equipment?
  - Can you decrease the workload of military members through automatic, electronic documentation?
  - How can you provide telemedicine for injured Airman in austere environments.
  - Can we provide automatic recording of physiologic devices that is inputted into electronic health record and/or to central monitoring system.
  - Machine learning tools can provide short lists of suggested actions to minimize opportunities for human error, and speed administrative processes.
  - Classification algorithms allow healthcare providers to request automatic alerts if patient data indicates certain patterns of concern or interest.
  - RFID-enabled hand-offs could be used to automatically gather certain patient data, and ensure it is preserved and accessible.
- Preparing the Airman (Selection, Training, Assignments, etc.)
1. In an environment where fewer young adults are fit to fight when recruited, how can the USAF leverage the most advanced and emerging techniques in health, sports medicine, nutrition, and fitness to optimize physical performance in the training of Airman?
  2. In a multi-domain combat environment where many skills may be needed and Airman must rapidly adapt to new missions, threats, and capabilities, how can emerging sciences and technologies in augmented and virtual reality be employed to select and train Airmen across multiple domains? How can this be done in a way that optimizes retention and minimizes resource requirements (fuel, energy, wash-out)?
  3. By utilizing maturing sciences such as machine learning, autonomous agents, and advanced sensing, can we turn the understanding of the machine into an understanding for the Airman? How would this be achieved? What are the gaps in understanding machine AI in terms of problem insight?

4. In an operational environment which includes teams of human-machine, human-human, and teams-of-these-teams, how can training be enhanced to prepare for an evolution in these technologies? What is required to make this possible in terms of S&T investment?
5. What new concepts can be employed for the optimal selection of Airmen with respect to multi-domain mission sets of the Air Force? In particular, for distinct reliance on cognition, physical, or other abilities?

- Sustaining the Airman

1. The Airman must be considered in the context of a long-term investment of national resources. What are strategies which extend the effective career of the Airman, provide for long-term well being, and ensure a healthy, productive life beyond time in service?
2. The revolutionary technologies of 2030 and beyond will create new and novel threats to Airmen in combat. What are the top priorities and most difficult to counter for the US to address? Will these be manifested as immediate, acute effects or be expressed over the longer-term, and more difficult to assess?
3. What technological advances will be employed to prevent physical and cognitive decline with age, or as a result of injury and fatigue?
4. How can evolving tactics of the adversary be quickly countered through on-demand, personalized training concepts to adapt the Airman (from combat to command) to an unforeseen battlefield across multiple-domains? Can this include the transmission of experience from one Airman to another?

- Augmenting the Airman

1. The Human may be optimized in terms of cognition and physical ability through training and experience. Performance can be enhanced through augmenting physical ability, effective communications, synthetic teammates and other approaches. What are the most impactful technologies which should be matured by 2030 in order to enhance abilities?
2. Can emerging synthetic biology concepts be employed to augment human performance in the next 15 years? If so, what are the most promising of these and the most impactful?
3. What are the hurdles for a human to operate in an environment with synthetic, artificially intelligent teammates? How should this be done effectively? What are the technologies and techniques which can be employed to ensure trust and optimal communication of information? How should this be done in a fashion that is consistent with the values of humanity?
4. Is it possible to make direct communication between the human nervous system and a machine in order to enhance the sensory capability of the Airman? Can the Airman be provided with senses not currently accessible through machine interfaces? Can these concepts be used to augment physical performance or mental capacity?