A Simple Premise

- Airplanes, satellites, ships, tanks, and soldiers alone do not yield combat power.

- Victory demands:
  - Realistically formulated **strategy**
  - Effective **operational concepts**
  - Accurate execution of **commander's intent**

- Modern, effective, resilient C2 is the keystone of future combat ops

"Victory in future combat will depend less on individual capabilities and more upon integrated strengths of a connected network for coalition leaders to employ"

-General David Goldfein, USAF (ret)

A Robust C2 Enterprise Is an Essential Investment

An Enduring Requirement

- ***Command and Control (C2):*** maximizing situational awareness to place mission assets at the right time and place to best achieve command objectives, while not projecting undue vulnerability.

    – **Command**: Authority to direct, coordinate, and control forces.

    – **Command and Control**: Exercising authority and direction over assigned forces to meet mission objectives.

    – **Command and Control System**: The facilities, equipment, communications, procedures, and personnel requisite for planning, directing, and controlling forces.

"Yet, in terms of grasping C2, networks do not explain that concept anymore than missiles explain air superiority or bombs describe global strike."

Lt Col Paul Maykish, *Air and Space Power Journal*, 2014

A Balance Exists Between Human Judgement and Technology

Imperative: A New C2 Construct

- The **rise of peer competitors** will place extreme demands on U.S. warfighting strategies—rapid, decisive, integrated multi-domain operations are essential.

- Record level of **high-demand**, low-density mission capabilities require efficient, precise employment.

- Existing **C2 infrastructure increasingly fragile** amidst surging demands and exceedingly vulnerable to attack.

- Disjointed fielding of **mass sensors, processing power, and connectivity** will undermine effective operations.

Failure to Rapidly, Decisively Evolve Risks Strategic Defeat

Seven Evolutionary Phases

- *World War I:* Command intent, minimal sensors, no real-time connectivity.

- **Opening of WWII:** Early networked operations empowered by ground-based sensors, controllers, and radio communications.

- *Early WWII:* Aircraft-based sensors paired with ground-based sensors and associated C2 functions.

- *Early Cold War:* Increasingly complex sensor networks, advanced command and control stations, and automated data transfer.

- *Mid-Cold War:* The transition of the C2 execution function to the sky.

- *Early 2000s to Present Day:* Distributed sensors, processing power and connectivity creating sensor-shooter complexes.

- *ABMS and JADC2:* Sensor-shooter constructs empowered by tremendous informational access, processing power, and collaborative data fusion in a domain agnostic, effects-focused fashion highly empowered by machine processes and artificial intelligence.

A Common Objective Amidst Rapid Technological Developments

An Enduring Vision

- *"We were able to detect aircraft we had not previously seen. It was somewhat frightening to realize I the past there had been so many aircraft we had not seen."*

    -USAF EC-121 Controller, Vietnam War

- *"I never heard my wingman calling me. When I got back to base, I listened to the tape of the mission, and as clear as day, he told me that a MiG was there and what I should do to avoid the attack. I didn't hear it. I was totally saturated."*

    -Col. Richard Borowski, F-4 Pilot, Vietnam War

- *"Going up the Red River…we had a procedure where we started turning off things like the detection gear for SAMs. It made noises, it bothered you. We turned off Guard channel because there was always someone screaming in an emergency. We'd turn off the sidewinders. I'd usually put the kid on the backseat [WSO] on cold mic so I could not hear him…and so I'd turn off all the noise so I could concentrate on the matter at hand."*

    -Brig Gen Robin Olds, F-4 Pilot, Vietnam War

- *"The perfect vision of potentially hostile air activity [via the AWACS] will enable a commander to position his forces with economy and mass at the proper time to deter, or to fight. We will have the time to think, reason, and act, rather than just react."*

    -Gen Robert Dixon TAC Commander, 1977

- *"We are swimming in sensors, so we need to ensure we don't drown in data"*

    -Lt Gen David Deptula, U.S. Air Force (Ret), 2009

- *"Without a unifying force that is C2, these amazing technological advances may realize only individual successes or localized advantage rather than broader operational-level advances."*

    Col Henry Cyr, Air and Space Power Journal, 2014

We've Been Here Before, Smart Action is an Imperative

Current State of Play

- C2 is more important than ever.
- The C2 enterprise is old, fragile, and fragmented.
- Components are diverse—everything from Reagan-era assets to 5th Gen and RPAs.
- C2 connectivity is assumed.
- Operational scale is limited.
- Services lack a unified path forward.
- Adversaries will attack the C2 enterprise.

"China's leaders [think] that achieving information dominance and denying adversaries the use of the electromagnetic spectrum is necessary to seize and maintain the strategic advantage in a conflict."

-DOD's 2020 *The Military and Security Developments Involving the PRC*

Underlying Imperatives

- C2 design strategy must integrate technology and human intellect to ensure command intent is translated into desired actions.
    - Mass flow of raw data does not equal effective C2.
    - Technology solutions are required to process mass data.
    - Human judgement is required to meet command intent—effective warfighting is not formulaic.

- Future solutions must temper technical overreach that will invite undue risk.
    - Must not confuse technological potential with guaranteed operational reliability in the near-to-mid term.
    - Viable fallbacks must exist if new solutions are not operationally effective.

- C2 design must be able to scale across the operational threat spectrum—from limited engagments to full peer conflicts.
    - Top peer threats will drive requirements, but the majority of warfighting occurs at the mid and low levels.
    - Mission-based-affordability is a key attribute.

Cautionary Tales

- Technology absent operational pragmatism:

  – Theater Battle Management Core System (TBMCS)
    - Designed in the late 1990s and early 2000s to automate planning and control of the air component.
    - Difficult to understand, hard to train new users, and did not match dynamic operational demand that emerged.
    - OEF and OIF saw operators work around the system through manual improvisation.

"The acquisition community had a utopian vision of a single, modern integrated, joint C2 system, but had no operator requirements to support it and no CONOPS that described how the system worked as a single integrated capability."

-MITRE

"The government did not produce a concept of operations, key operational performance parameters, or a system specification for the contractor."

-Air Force Institute Of Technology

Technology Must Be Guided by a Encompassing Vision

Cautionary Tales

- Mass data, no realistic processing plan, and legacy management constructs:

  – Rise of the sensor-shooter absent a holistic enterprise.
  - RPAs, targeting pods, and ubiquitous connectivity—amazing raw power.
  - Airmen saw a 5,000% increase in sensor data produced without a corresponding means to process it in a sustainable, relevant fashion.
  - Commanders "reaching" into cockpits.
  - Aspiration to net "immaculate" operations to the detriment of real-world combat effects.
  - Inability to recognize the dual applicability of sensor-shooters in the planning process dramatically undercut achieving mission goals.

"In the age of abundant, almost limitless, information and communications capabilities, decision makers are increasingly faced with the problem to too much information, rather than too little."

-RAND

"…an F-16 provides armed reconnaissance along a route that friendly forces will patrol the following day, oblivious to the fact that an MC-12—in an overlapping orbit—has found and fixed a high-value target, hoping that a strike asset arrives in the area before collateral concerns preclude an attack."

-Maj Matt Gaetke, *Air and Space Power Journal*, July-August 2014

Capability Advancements Demand an Enterprise Approach

ABMS and JADC2

- Seeks to create partnerships at given times and places to achieve desired effects better than what any single asset could net individually.

- Harnesses distributed sensors, connectivity, processing power, and effectors.

  - <u>ABMS</u> is the technical means of information exchange and processing.

  - <u>JADC2</u> is the overarching concept aligning commander intent to operational and tactical level actions.

- Key Questions:

  - *How are massive amounts of data gathered by the enterprise being filtered and fused to prevent saturation?*

  - *Who is exercising C2?*

ABMS and JADC2

- Key components:
    - 5th generation aircraft, manned-unmanned teaming partners, and space-based sensors will gather data in defended regions.
    - AI, automation, and machine learning will process mass flows of data.
    - Human C2 experts will drive commander's intent amidst complex scenarios, add clarity in dynamic situations, and avoid predictable responses an enemy can anticipate.
    - Battle management C2 must be geographically tiered throughout the battlespace given that connectivity grows fragile with distance.
    - C2 and ISR are divisible and must be treated as such.

Next Gen Manned C2 and ISR

- The human component should be tiered throughout the battle space.

- Attributes:
  - Must be survivable
  - Open mission systems
  - Modular sensor packages
  - Ability to segregate C2 from ISR and mission requirements demand
  - Connect to regional portions of the battle space.
  - Scale to meet demands throughout the spectrum of conflict.

"I think leading [battlespace] edge systems are going to have to be quarterbacked by people that are standing back to make the calls."

-Dr Will Roper

Potential Courses of Action

- Extend service lives of AWACS and JSTARS:
  - Current capability
  - Could be upgraded

- Current production option like E-7 Wedgetail:
  - Modern, known quantity available now
  - Allied interoperability
  - Cost likely on par with legacy upgrade expenses

- C2 experts on another aircraft, like KC-46
  - Modular approach harnesses available assets
  - Takes advantage of separation between C2 and ISR
  - Additive presence

- C2 and ISR application for a supersonic business jet:
  - Speed provides operational responsive reach
  - Wide set of basing options
  - Altitude and speed afford survivability
  - Modular and OMS by design
  - Built to separate C2 from ISR

*Bottom Line: Human C2 Experts At the Right Time and Place*

Key Take-Aways

- C2 is all about empowering effective combat power.

- ABMS and JADC2 will require technologies like 5th Gen, AI, machine learning, and robust connectivity.

- An appropriately tiered layer of human command expertise will prove essential in the battlespace.

- C2 must be effective, sustainable, and affordable across the operational spectrum.

- A high speed, high altitude C2 and ISR aircraft with "look-in" capability can empower the command construct.

"Command is both an organizational function and a cognitive function, and technology, by itself, is not a panacea."

-RAND, 1999
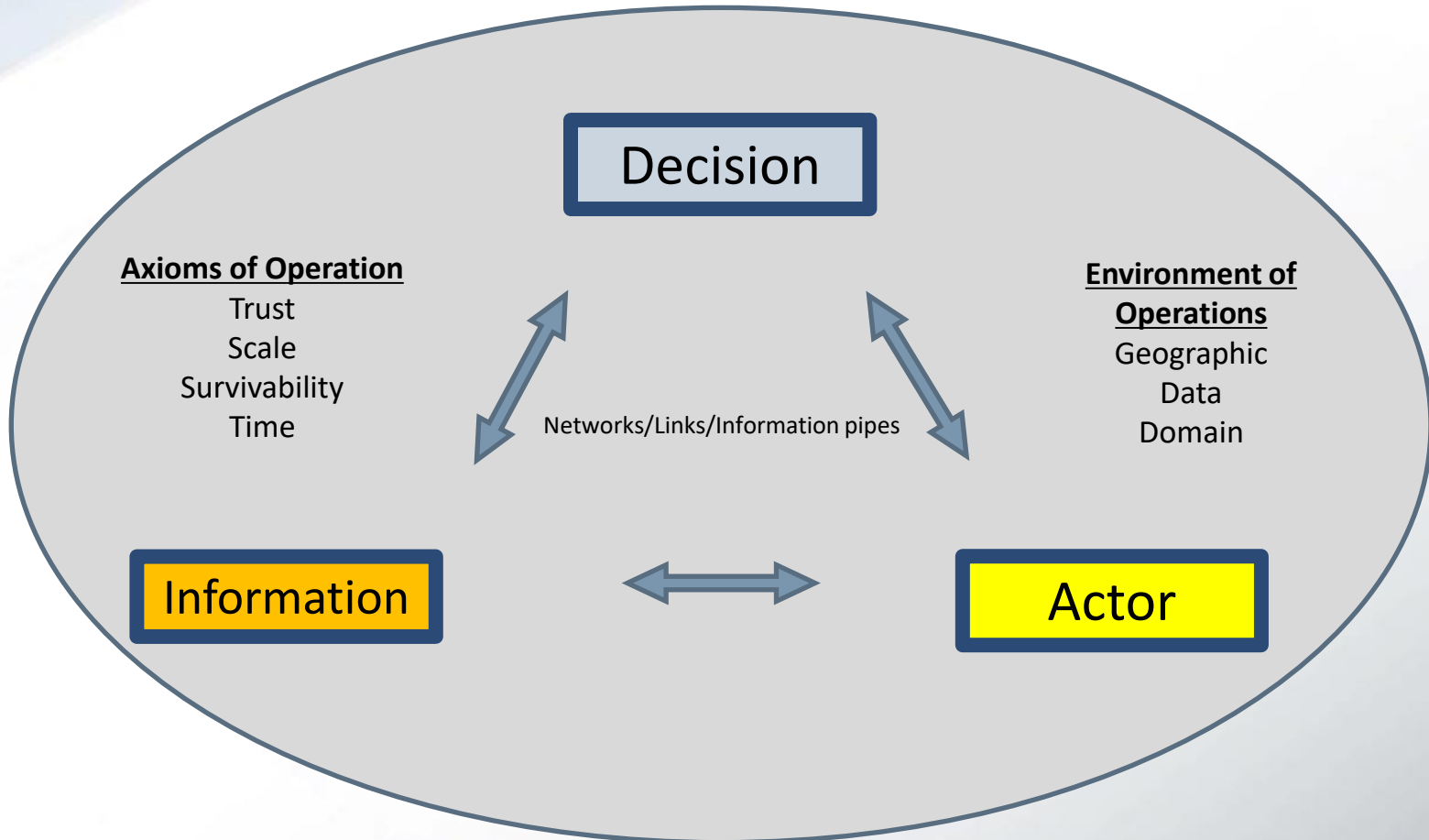
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