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PLA INFORMATION SUPPORT TO THE BATTLEFIELD: UAV EMPLOYMENT CONCEPTS AND CHALLENGES

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Executive Summary

China's extensive investments in unmanned systems and their incorporation into informatized and eventually intelligentized warfare is a central component of the People's Liberation Army's (PLA's) modernization. The PLA Services—particularly the PLA Army (PLAA), PLA Navy (PLAN), and PLA Air Force (PLAAF)—are all developing capabilities that will rely on unmanned aerial systems (UAS) to provide key enabling information to kinetic and information operations. The PLA does not expect to be intelligentized until 2035 and was "basically" mechanized only by 2020.[1] For a force seeking to take such a massive conceptual and technological leap, it cannot be assumed that operational integration and readiness of new advanced platforms is advancing at the same pace as technical innovation. It is important to interrogate current PLA concepts of the employment of currently fielded systems to understand how the PLA might employ its force through the varying levels of armed conflict in the near term.

Previous Research and Current Methodology

The PLA has a long-established and researched history of developing unmanned systems for modern combat operations. There is a significant body of research from both the pre-2016 PLA reorganization and post-reorganization on the PLA's focus on developing unmanned aerial vehicles and its demonstrated employment of unmanned systems across the services of the PLA. Most of the more current research devoted to this topic by Western observers focuses on describing platform capabilities, identifying units equipped with these platforms and the organizations driving operational requirements, and outlining general operational concepts.[2] Other sources combine coverage of PLA training and operations in and around contested territory to paint a picture of how operational elements employ UAVs in some of the closest contexts the PLA has to actual combat.[3] Similarly, some sources highlight the potential utility of these systems in specific contingencies, including highly contested regions such as the South China Sea.[4] Other research focuses on the PLA's future concepts, such as UAV swarm technology.[5] In 2021, the U.S. Department of the Army published ATP 7-100.3, which explains how the PLA Army employs UAV systems to perform reconnaissance and targeting at the brigade level and below.[6] This publication is quite comprehensive on this matter, but it does not explain the PLA rationale behind its stated employment ranges and practices, nor does it provide higher level detail regarding how the PLA categorizes UAVs by type or function within a Group Army's unit echelons.

This article presents the perspectives of individuals affiliated with the PLA and the PRC's defense industrial base by analyzing their writings about UAV information support employment concepts, providing insight into how PLA-affiliated thinkers evaluate the utility of UAVs and their tactical applications. This paper begins by summarizing how PLA doctrinal education texts incorporate discussion of unmanned aerial vehicles (UAVs) in some of the key textbooks guiding PLA development. Explaining how these strategic-level documents discuss the utility of UAVs demonstrates the high-level emphasis on these systems and describes how they broadly support PLA modernization goals and warfighting styles. This paper then focuses on academic writings by individuals affiliated with the PLA and the defense industrial base published in academic publications and PLA media since the PLA's reforms that began in 2015 in order to identify assessments regarding the PLA's progress in employing UAVs across all domains for intelligence, surveillance, and reconnaissance (ISR), communications and data transmission, and information operations.[7] These sources analyze UAV employment and capabilities and reveal the underlying assumptions regarding UAV operations used to baseline technical analysis. Finally, we examine the challenges to integrating UAV technology as identified in the PRC-sourced literature. This addition to the body of research sheds light on how PLA academics think about the PLA's UAV employment at the operational and tactical levels.

KEY FINDINGS

PLA authors view unmanned systems as essential to modern warfare and an area of key competition to "seize the commanding heights" of future military competition.[8] The sources reviewed for this paper reveal the following insights into perceptions of PLA-affiliated authors:

- Broadly speaking, PLA authors' analysis of UAV operations emphasize the speed, flexibility, and low costs of ISR UAVs as key strengths that enable comprehensive awareness of the battlespace. These authors also emphasize accelerating kill-chains, providing real-time and responsive intelligence and battle damage assessment (BDA), and otherwise shortening the "observe, orient, decide, act" (OODA) loop. Such priorities are emblematic of the PLA's emphasis on the primacy of the information domain and the impact of operations in the information domain on operations in other domains.
- Across domains, PRC scholars view ISR UAVs as important for enabling situational awareness, enabling fires, and ensuring safe maneuver. ISR UAV missions and tactics largely provide direct support to operational units for reconnaissance and targeting, particularly PLAA combined arms brigades, PLAN surface ships, and PLAAF air defense units. For ground domain operations, authors highlight the advantages of providing UAV-provided ISR, targeting, and BDA capabilities to as low an echelon as possible and also place heavy emphasis on the utility of low, slow, and small UAVs for urban operations.
- By acting as signal relays, UAVs are important for communications network range and resilience and can also support cognitive domain operations.
- While PLA authors view UAV-supplied ISR as an important enabler of future multi-domain joint operations, the PLA appears to be struggling to integrate UAVs into joint multi-domain operations due to technical and cultural factors, making the establishment of a truly joint kill-web still aspirational.[9]

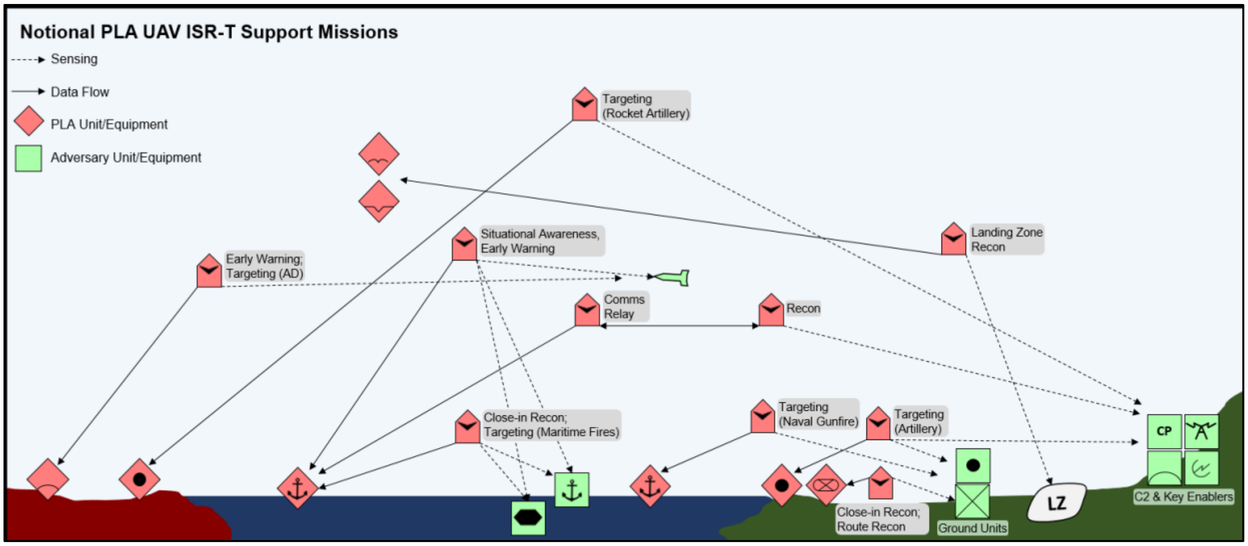

Figure 1: Summary of UAV Missions Identified in PLA Academic Writings

ASSESSMENTS OF UAVS IN PLA DOCTRINAL EDUCATION TEXTS

PLA authoritative academic texts have long emphasized the importance of unmanned systems and their contributions to ISR and other information support missions on the future battlefield. Published in 2003, *Integrated Aerospace Information Warfare* (空天一体信息作战) outlines UAVs' ability to surveil an enemy's rear area and guide munitions onto targets as an important use case of these systems.[10] The 2006 *Science of Campaigns* discusses UAVs in the limited role of supporting suppression of enemy air defense operations using electronic jammers and kinetic strike, tactics inspired by Israel's UAV employment against Syrian air defenses in 1982.[11] By 2009, the textbook *Precision Operations Command* remarks that UAVs had already become the primary means of battlefield reconnaissance, target designation, and damage assessment.[12] The 2013 edition of the PLA Academy of Military Science's *Science of Military Strategy* (SMS) reflects an expanded interest in UAVs, emphasizing that unmanned systems have played an increasingly prominent role in an increasingly multi-dimensional battlefield, and in concert with other technologies would eventually cause revolutionary changes in operational theory, operational patterns, and ultimately the structure of nation's militaries.[13] The 2020 edition of SMS, published by the National Defense University, identifies the supporting role of intelligent unmanned systems as indispensable for modern military operations.[14] The 2020 edition of SMS highlights that UAVs carried by surface ships can enable reconnaissance of larger areas and better early warning at sea.[15] Over time, these publications have expanded their descriptions of UAVs roles and importance to overall military modernization.

ISR, Targeting, and BDA Missions

PLA-affiliated authors contend that UAVs increasingly contribute to ISR operations. Overall, UAVs have expanded the "three-dimensional" nature of the battlefield by operating from high altitudes to extremely low altitudes and being able to effectively conduct close-range reconnaissance.[16] This section summarizes how PLA-affiliated authors describe UAV ISR-Targeting (ISR-T) missions across domains.

ISR-T Support to Ground Domain Operations

According to Chinese sources, prior to conflict, UAVs can provide data for intelligence preparation of the battlefield. For example, authors from PLAA Unit 31696, the 79th Group Army artillery brigade garrisoned in Jinzhou, suggest that remote-sensing UAVs can survey and map urban structures in support of military operations.[17] UAVs, particularly large- and medium-sized UAVs, can be used for long-distance reconnaissance to monitor enemy movements and disposition.[18] UAVs are particularly valuable for intelligence collection within enemy territory because they provide a lower-risk solution than manned reconnaissance aircraft for conducting ISR.[19]

During conflict, UAV ISR is an element of multi-dimensional reconnaissance systems, which are capable of deploying in various configurations determined by commanders based on the battlefield environment and disposition of enemy forces.[20] The PLA's primary ground combat unit, PLAA Combined Arms Brigades (CAB), possesses different types of organic UAV systems operated at different echelons within the brigade, with different capabilities and missions. Authors affiliated with the PLA Army Command College (陆军指挥学院) categorize UAVs employed at different echelons within a CAB based on the range of these systems: UAVs with a combat radius of less than 100 kilometers are classified as short-range reconnaissance UAVs (近程侦察无人机) and are typically subordinated to units at or below the brigade level. Super-short-range recon UAVs (超近程侦察无人机), on the other hand, have a combat radius of a few to tens of kilometers and are generally used by units below the battalion level.[21]

For PLAA CABs, ISR UAVs are tasked primarily with using IR sensors to augment ground-based recon elements to detect concealed enemy forces.[22] The PLA Army Command College authors indicate that CAB commanders will be responsible for organizing and coordinating UAV operations to focus UAV ISR support on the main ground combat forces.[23] Intel centers should be responsible for ingesting intelligence collected by UAVs and conduct battle damage assessments where necessary to better inform commanders.[24] In this context, UAVs are vital tools used to identify key points, defensive positions, and weak links, and to guide ground forces to assault positions. PLA-affiliated authors note several distinct UAV reconnaissance tasks in support of ground operations:

- **Landing Zone Recon:** UAVs can be used to augment reconnaissance elements to conduct reconnaissance in landing areas for airborne operations, including in securing landing areas behind enemy lines.[25]
- **Perimeter Security:** UAV ISR is viewed as important for detecting enemy infiltration and sabotage attempts and supplementing or replacing security forces around key facilities or locations.[26] In a 2024 exercise, the security element of an 81st Group Army Heavy

Combined Arms Brigade employed UAVs to investigate suspected enemy activity near their unit's position.[27]

- **Route Monitoring – Logistics:** UAV ISR could be used to support resupply, logistics, and medical support operations by conducting route monitoring and alerting those units of potential obstacles or threats.[28]
- **Route Monitoring – Complex Terrain:** Route monitoring, especially in complex terrain such as jungles and urban settings, is also an important UAV ISR task.[29] In an autumn 2024 exercise, a 75th Group Army reconnaissance unit used ISR UAVs in mountain jungle terrain to identify enemy positions on planned routes.[30]
- **SIGINT Collection:** UAVs could be used to conduct technical reconnaissance to monitor key enemy positions such as command posts, radar stations, communications hubs, and artillery positions.[31]
- **Maneuver Unit Forward Recon:** Super-short-range UAVs can be used to conduct low altitude recon missions in the lead up to an advance to identify enemy positions and defensive points, and to guide strikes onto targets.[32] This year, a 73rd Group Army Armored Infantry Squad exercised this task by employing organic UAVs for close reconnaissance and identification of enemy positions.[33] PLA Army Command College authors highlight the possible tactic of moving these UAVs to the flanks of advancing force to free up the airspace immediately above friendly forces.[34]

Figure 2: ISR UAV Launching for a Recon Mission during an April 2024 PLAA Training Exercise[35]

In addition to reconnaissance tasks, PLA authors commonly discuss the use of UAVs to provide target acquisition to support kill-chains, particularly artillery fires. PLA authors assess that small UAVs are increasingly important for identifying targets for indirect fire missions and conducting fire mission BDA.[36] *China Military Online* coverage of PLA army artillery exercises emphasizes that UAV ISR conducted at the company level is superior to traditional land-based reconnaissance because UAVs offer longer range, multiple perspectives on the target, is suitable in low-visibility conditions (e.g., fog), and provides improved data accuracy and target acquisition time.[37] A *PLA Daily* article from August 2023 discusses the use of ISR UAVs for multiple points in the artillery fire kill-chain, including target acquisition, adjustment of fire, and BDA, during a 77th Group Army exercise.[38] *PLA Daily* reporting from November 2024 about an Eastern Theater Command artillery unit exercise describes a UAV team transmitting UAV target acquisition data and post-strike images to the artillery battalion command post for fire direction and BDA.[39]

PLA observations of foreign military conflict support the integration of UAVs into kill-chains, noting the effective widespread use of small UAVs by infantry, artillery, armored, and airborne troops in recent conflicts.[40] Observations of the Russia-Ukraine war emphasize the tightening of kill-chains that UAVs allow. PLA authors observe that using UAVs on the battlefield in Ukraine shortens kill-chains for artillery strikes from around 30 minutes to less than five minutes for counterbattery fire by coordinating direction finding, acoustic positioning, and other electronic detection means.[41] The Russia-Ukraine conflict has shown the utility of UAV ISR to units down to the tactical level for conducting live target tracking and sharing that information with command posts to coordinate fires with up-echelon units.[42] Commentators have also noted the importance of the ability of the TB-2 UAV, a strike-capable medium-altitude, long-endurance (MALE) UAV, to operate with degraded or denied access to GPS.[43]

PLA-affiliated authors also note UAVs' value for coordinating fires between domains, with an emphasis on coordinating with army aviation and artillery to destroy fixed targets, implementing effective suppressing fires in-depth, and opening up landing areas for air assaults or airborne operations.[44] A *PLA Daily* article from October 2024 describes a 75th Group Army's Air Assault Brigade exercise that employed UAVs to conduct reconnaissance of the air assault landing zone and provide target location data directly to attack aviation.[45] Previous research indicates that PLAAF Airborne Corps combined arms brigades' reconnaissance and pathfinder battalions (侦察引导营) appear to operate small UAVs to support their operations;[46] however, current open source analysis has indicated that Airborne Corps units do not appear to train with other services, including the PLA Army, to achieve their objective of marking and securing landing zones with supporting fires.[47]

ISR-T Support to Urban Operations and Close Reconnaissance

The PLA has emphasized the strengths and utility of using small UAVs in urban settings to conduct reconnaissance and surveillance in this challenging operational environment. The PLA clearly views these systems as vital to maintaining situational awareness, identifying targets, and prosecuting targets in contested urban environments.

PLA Daily authors note that micro- and small-sized UAVs, also characterized as low, slow, and small (LSS) UAVs, are increasingly used in ground operations, particularly special operations and urban operations, for increased battlefield awareness. Their small size makes them easy to transport, launch, and use. They are also hard to detect due to their small radar cross section and quiet operation.[48] Additionally, these UAVs have higher survivability because integrated air defense systems are not suited for tracking, fixing, and engaging small low altitude UAVs and are not economical to employ against such inexpensive targets.[49] PLA authors highlight these systems' ability to conduct close-in reconnaissance, noting their maneuverability, ability to operate in confined spaces, and ability to move undetected in and out of buildings and underground structures.[50] Despite these advantages, small UAVs have short ranges and small payloads, limiting their mission suitability to only low altitude ISR.[51]

Authors describe urban environments as having complex electromagnetic environments that hinder defenders' ability to identify and track small UAV targets, though they concede that more training and better equipment will enable defenders to prosecute these targets in the future.[52] Given the difficulty of countering these systems, the short-range operation of expendable small UAVs and LSS UAVs are well-suited to targeting military and civilian infrastructure or assembly areas, particularly in urban environments.[53]

Authors note that while for larger systems the trend of integrating ISR and strike platforms is progressing, the payload limitations of small UAVs will require them to operate in formations, with some systems conducting ISR and other systems carrying or acting as munitions.[54] This dynamic can be seen on the modern day battlefield in the way which Ukrainians and Russians appear to prefer to use the DJI Mavic quadcopter or similar small UAVs to conduct ISR and smaller, more agile first person view drones to deliver munitions.

As automatic target recognition technology improves, PLA authors indicate that small UAVs will greatly improve the ability of close-in reconnaissance troops to identify and target concealed or moving targets.[55] As camouflage techniques become more effective, more complex technical solutions will be necessary to image targets and process imagery of targets to automate target recognition. The author's note that given these technical demands, the computing power needed to store and match targets against target feature libraries will require close-in reconnaissance soldiers to carry terminals to process information as fast as possible since small UAVs may not have the onboard computing power necessary to process the images they capture.[56] The authors highlight several target recognition algorithms developed by Chinese universities, including Northwestern Polytechnic University. The authors indicate that at this time the computing necessary to compare visible light imagery, IR imagery, and other target data within a target library must be done by a UAV ground station.[57] The author's note here that contested communications conditions may put further strain on the system and prevent real time target recognition.[58]

ISR-T Support to Maritime Domain Operations

In the maritime domain, UAVs are described as key enablers and providers of ISR and targeting. *China Military Online* authors highlight that shipborne UAVs are the "rising stars" for seizing air superiority in maritime operations given their ability to undertake various reconnaissance and combat missions to support the "air-space-sea" information network system.[59] UAVs address key requirements of modern naval warfare, such as beyond visual range sensing, wide area coverage, multi-domain integration, and a high degree of intelligentization (高度智能化) (i.e., a higher level of autonomy enabled by AI).[60]

PLA-affiliated authors emphasize UAVs' attributes that make them superior to traditional maritime ISR methods, including shipborne ISR and helicopters. Carrier-based UAVs expand the range of battlespace awareness, providing commanders with much broader situational awareness farther from carrier formations.[61] As described in the *PLA Daily*, "the detection range of ship radar is limited by the curvature of the earth and has a poor ability to detect low-altitude targets and maritime targets beyond visual range," while UAVs offer longer dwell time, longer flight and sensor range, and higher maneuverability than ship-based sensors or carrier-based helicopters for providing ISR.[62] The long dwell time of UAVs is also suitable for continuous ISR missions. Like in ground domain operations, UAVs are suitable for close-in reconnaissance due to the low cost of losing the platform and lower risk to human life.[63] Additionally, in maritime operations, UAVs offer higher survivability, as UAVs have a small radar reflection area that is difficult to detect.[64] The flexible nature of UAV employment enables real-time tasking for missions like BDA, and UAVs can dynamically change flight paths to provide real time feeds of strikes, target effects, and casualty information.[65]

Figure 3: PLA-affiliated Authors' Assessments of UAV Advantages for Maritime Missions

Given these advantages, authors identify several ISR-T missions suitable for shipborne UAVs. Shipborne UAVs can conduct long-range patrols to provide early warning detection and reconnaissance of air, sea, and sub-surface targets to the carrier group.[66] For example, the development of high-speed, long-range attack weapons, combined with the low availability of carrier-based early warning aircraft, challenge carrier battle groups' early warning capability; however, shipborne high-altitude, long-endurance (HALE) UAVs present a potential solution to greatly expand fleet situational awareness and early warning detection capabilities.[67] Shipborne UAVs also can supplement other sensors by using their longer range and close reconnaissance ability to obtain higher fidelity battlefield information in order to corroborate early warning signals.[68] Additionally, *China Military Online* authors note that due to their higher speed, shipborne UAVs can more efficiently patrol islands and reefs than surface patrol vessels.[69]

In addition to providing battlespace awareness and early warning, UAVs can provide targeting data to support maritime fires. Shipborne UAVs can provide tactical ISR for maritime operations using EO and radar sensors to detect surface and low-altitude targets.[70] Shipborne UAVs can augment anti-submarine warfare (ASW) operations with acoustic or non-acoustic sensors or launching sonar buoys.[71] During amphibious landing operations, shipborne UAVs can support targeting or organic integrated surveillance and attack capabilities by monitoring surrounding sea and coastal areas and by gathering information about enemy landing obstacles and firepower configurations.[72] As early as 2004, PLA authors noted the United States' use of UAVs for targeting for beyond-visual-range naval gunfire support in the Gulf War.[73] A 2017 article by Naval

University of Engineering authors suggests that PLA researchers continue to optimize UAV target localization methods for this naval gunfire support mission.[74]

Autonomous capabilities are important enablers for UAV support to maritime operations. *China Military Online* authors note that most shipborne UAVs have automatic cruise and remote control flight capability that enables autonomous flight using sensitive sensor systems, satellite navigation equipment, and tactical universal data link and flight control systems.[75] PLAN authors assess that shipborne UAVs using automatic target recognition are suitable to assist the China Coast Guard and PLAN with identifying, tracking, and collecting image/video evidence against small fast boats, such as those used for illegal maritime activities in the Gulf of Aden and other strategic sea lines of communication.[76]

The PLAN has an established historical interest in developing the capabilities to field a truly joint multi-domain kill-web. In an article examining the dynamic kill-web operational concept in naval combat, authors from Dalian Naval Academy include shipborne UAVs as a key ISR asset, envisioning cross-domain integration of sensors and shooters in which space-based ISR provides primary maritime target identification that then cues HALE UAVs for additional reconnaissance and target identification and confirmation.[77] While this likely remains an aspirational capability currently, it might be an achievable capability in the near term within the aviation, ground, and maritime forces of the PLAN.

ISR-T Support to Air Domain Operations

Authors identify UAVs' low cost and expendability, ability to provide timely intelligence, and ability to avoid climate interference as key traits that could make them a key capability to support air and missile defense in a contested environment, particularly in mountainous areas or on remote islands.[78] An article by Air Force Engineering University authors argue that UAVs can play multiple roles in supporting air defense operations by enhancing early warning and acting as an eye in the sky (空中之眼), a shield in the sky (空中之盾), a network in the sky (空中之网), and a link in the sky (空中之链). Of these, the authors characterize eye in the sky and link in the sky functions as furthering an air defense networks' ability to detect and track targets. UAV's operational altitudes can augment radar horizons to detect targets that would otherwise be able to use terrain masking to their approaches from air defense systems.[79] Airborne UAVs can also augment air defense networks radar detection by providing operators enough time to detect low, slow, and small targets at farther ranges than terrestrial radar systems alone can.[80] Authors also note that UAVs can provide tracking and guidance quality information that enables ground-based interceptors to cooperatively engage airborne targets (Figure 3).

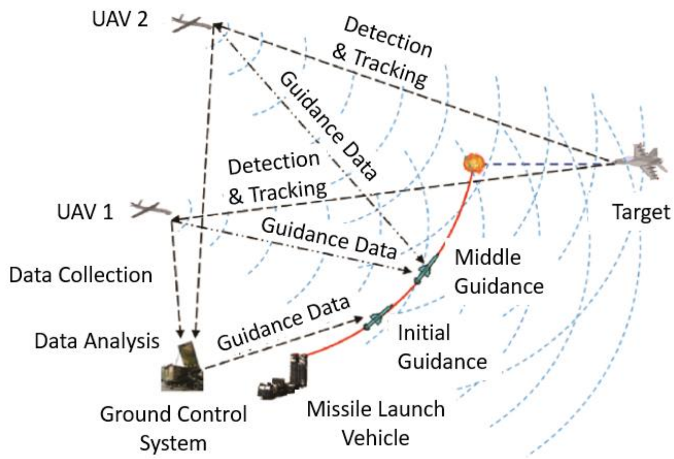

Figure 4: UAV Relay Guidance Against Air Raid Targets[81]

ISR-T Support to Electronic Warfare Operations

In the information domain, UAVs can also play a key role in signals intelligence collection to support reconnaissance and electronic warfare (EW) operations.[82] For example, in maritime operations, UAVs' low-risk close-in reconnaissance capability allows collection against enemy targets that shipborne sensors cannot accomplish. UAVs have greater ability to collect enemy platform signal signatures and parameters to aid target identification and EW because of their larger combat radius and altitude range; surface ships can only conduct electronic countermeasure reconnaissance on a single plane and are limited by line-of-sight range.[83] Additionally, PLA authors assess that because UAVs can collect radiation sources at shorter range and thus stronger signal strength, the sensitivity and accuracy requirements of sensors are reduced and simplified compared to ship-based sensors.[84]

Drawing on observations of foreign conflicts, PLA authors emphasize UAVs' capacity to provide electronic warfare (EW) support on the battlefield. PLA-affiliated authors recognize that the Russia-Ukraine war has demonstrated the importance of effectively employing unmanned systems on the modern battlefield across the traditional domains of land, sea, and air, as well as actively engaging the network domain to enable effective operations and provide vital electromagnetic (EM) spectrum awareness.[85] UAVs are perceived as able to provide both continuous ISR coverage and comprehensive EM domain awareness. Furthermore, UAVs allow their operators to better integrate and coordinate kinetic and information domain strikes. Despite this enhanced EM domain awareness, it is conceded that UAVs further complicate the information domain due to their ability to conduct precise EW confrontation missions and precision operations in other domains.

Communications and Data Transmission Missions

Support to Communication Network Resilience

The PLA's centralized, level-by-level command biases combined with its overall modernization drivers focused on informationization and intelligentization indicate a continued and increased reliance on resilient, uninterrupted communications and data flows between fielded forces and their up-echelon command posts and mainland-based command centers. While the literature reviewed for this paper does not suggest that UAV-supported datalinks will be integral to transporting data domestically to central command centers, UAV airborne relays are clearly viewed as a key component of sharing information between deployed formations and command posts in the field. UAVs can reinforce communications by serving as flexible and fast-response signal relays.[86] PLA authors view UAVs as an important contribution to communications networks, providing extended range and resilience in adverse weather and terrain.[87] In addition to extending communications ranges, UAVs can supplement degraded communications in contested conditions by transmitting communications within a formation and to subordinate and superior formations.[88] Moreover, UAV networking functions are also identified as a means to bolster linkages in the ground-based air defense information network, improving the network's ability to coordinate low and ultra-low altitude target engagements.[89] UAVs can provide data to ground-based air defenders by acting as data transmission nodes between manned air domain ISR platforms and ground-based command posts.[90]

Extending communications and data transmission is a primary mission for shipborne UAVs as well. Shipborne UAVs can relay visual range communications over-the-horizon between ships.[91] Mesh network communications equipment on UAVs enables long-distance communication and command and control (C2) relay between multiple platforms, such as helicopters performing missions at low altitudes, UAVs performing reconnaissance operations beyond visual range, and ships beyond visual range.[92] *China Military Online* authors note that "some drones modified from reconnaissance helicopters can be used as communication relay platforms, equipped with network attack and defense systems, so that signals can cover areas within 400 kilometers."[93]

Observations of the Russia-Ukraine war by individuals affiliated with the PLA also may offer insight into how important the PLA considers the effective integration of these ISR enablers into a broader C2 system. Integration of unmanned systems into the command information system will be an effective means to achieve important capability modernization milestones.[94] Despite not being used in this war to effectively establish battlefield networks or act as communications or data sharing nodes, UAVs are thought to be important to establish stable and resilient networks that can be employed flexibly across large areas.[95]

Support to Cognitive Domain Operations

PLA-affiliated authors suggest that UAVs can be used to transmit data in support of cognitive domain operations, also known as information operations. By impersonating temporary virtual base stations (时虚拟基站), UAVs could be used to transmit messages via text message to enemy forces for the purpose of persuading surrender, exerting psychological pressure on combatants, and undermining will to fight.[96]

Data collected by UAVs can also support cognitive domain operations. Publications on the Russia-Ukraine war note that Ukraine has turned UAV footage of strikes or combat into a potent messaging tool that has enabled it to seize the initiative in the cognitive domain and generate global public support.[97]

Challenges to Integration

As of 2023, obstacles to effective implementation of unmanned systems in cross-domain joint operations appear to persist within the PLA. One PLA discussion suggests that in an ideal system, coordination of C2 and intelligence across domains can enable jointness down to the tactical level; however, these authors, affiliated with National University of Defense Technology (NUDT/国防科技大学), claim that the PLA is still in the phase of developing concepts, key technologies, and systems integration management processes for coordinating the use of unmanned systems across domains.[98] While highlighted successes in coordination between ground and air domains in the public security space suggest progress, these authors do not appear confident in the PLA's near-term adoption of systems or implementation of associated tactics, techniques, and procedures (TTPs) to enable joint multi-domain operations.[99]

Starting at the Theater Command level, these authors claim that the current command information systems used to support campaign-level joint operations planning are effective, but cannot meet the planning needs of joint forces at the tactical level.[100] These authors indicate that each service has its own closed tactical mission planning system that is not interoperable with other services' systems, leading to a tactical planning system incapable of effectively planning coordinated joint multi-domain operations.[101] Similarly, the centralized resource management planning system cannot interact effectively across the services to generate resource support plans for joint multi-domain operations. Additionally, equipment interoperability appears to be a persistent issue, and authors note that while command-level coordinated operations or movement is possible, fire control coordination is impossible.[102]

In addition to command information system barriers, the authors indicate that the PLA's top-down command and cultural preferences conflict with the real-time flexible and agile decision-making required to effectively conduct tactical-level joint multi-domain operations.[103] Given these cultural preferences, not only does the skip-echelon tendency of higher-level command authorities pose an issue, the authors identify the time it takes to transmit information effectively up and down the chain of command as a lingering problem.[104] Given the barriers identified, the authors write that a mission-centered cross-domain planning information system is necessary to do ad hoc planning under constrained resources to enable commanders with the most situational awareness and opportunity to take the initiative.[105] Adopting this new approach is incumbent on accompanying cultural changes that have yet to take root despite being forced upon the PLA through various means.

The UAV CONOPs collected from the sample of articles reviewed for this paper often reflect this lack of jointness. Most articles that discuss support missions for UAVs describe ISR and communications support within a single service and targeting support to specific kill-chains. None of the articles reviewed explicitly describe joint UAV operations other than as aspirational. Media coverage also suggests the PLA has issues with joint UAV training, with one article noting difficulties negotiating PLAA UAV unit training at PLAAF airfields, which is required due to infrastructure limitations at PLAA facilities.[106]

The effective operation and integration of UAVs into the ISR-enabled strike complex at all echelons critical to the successful execution of informatized local wars. The sources consulted for this paper suggest that PLA authors view UAVs as an increasingly important generator of ISR information and a potentially important component of supporting the transfer of information across domains. Given this role, the PLA might believe timely UAV-supplied ISR as a component of the solution to overcome the barriers that PLA organization and culture pose to conducting effective joint operations, such as the PLA's cultural bias towards centralized command that impairs timely decision-making and down-echelon mission execution.

In addition to lack of jointness, PLA authors raise the issue of uneven integration of UAV systems within services. The PLA has undertaken an ambitious approach to quickly incorporating numerous UAVs serving a wide range of missions from strategic to tactical. Logically, this requires distributing resources and prioritizing the integration of some systems over others. Authors affiliated with the PLA Army Ordnance Noncommissioned Officer School report that the PLA Army has been slow to integrate smaller multi-rotor UAVs, at least as of 2018. The authors lament this slow integration, arguing that these systems have high value to the force, particularly in that they are simple to use and easy to repair on the battlefield.[107] A 2022 *China Military Online* report reveals the nascent and developmental nature of PLAA UAV operations, describing that PLAA UAV reconnaissance platoons supporting artillery targeting had limited specialized UAV training doctrine or resources after their establishment in 2017, and only over the intervening five years was a training program established.[108]Additionally, the PLAA faced challenges integrating new UAV platforms into operational concepts. As of 2019, the PLAA lacked standardized TTPs for coordinating UAV operations between ground stations and the ground forces they support. Key gaps identified include timing coordination, airspace management, and spectrum management.[109] Lack of standardization in ground stations prevents single ground stations from operating multiple types of UAVs or multiple ground stations being able to control one UAV.[110]

The PLA also faces technical challenges with UAV integration. For example, China Coast Guard and PLA Navy authors note several ongoing challenges with employing shipborne UAVs, including environmental factors requiring specialized materials to prevent corrosion, UAV take-off and landing, and limited storage space on ships, likely a reference to frigates, destroyers, and cruisers with limited ability to host longer range higher endurance systems.[111] Currently, the bulk of the PLA Navy's UAV forces are composed of shore-based regiments from the Eastern and Southern Theater Commands. There is evidence that carrier based aviation has begun integrating UAVs into carrier aviation operations.[112] Marketing material suggesting GJ-11s are carrier capable, and mockups of GJ-11s appearing on the aircraft carrier mockup in Wuhan have provided further evidence of the PLAN's ambition to incorporate more capable unmanned systems into its carrier-based ISR capabilities.[113][114] The recent launch of the world's largest amphibious assault ship and the construction of a dedicated UAV carrier testbed for the PLAN suggest the PLA is taking steps to overcome some of these obstacles, but the actual refinement of employment concepts and development of TTPs will take some time until after these platforms become fully operational.[115]

PLAN observers have noted several weaknesses in Russian and Ukrainian employment of UAVs, which may reflect historical challenges the PLA itself has faced. PLA-affiliated authors point to the lack of integration of UAVs into more complex operations in the Russia-Ukraine War, noting that many UAVs appear to have been deployed one at a time instead of being integrated into a large system.[116] Moreover, fragile datalinks and C2 linkages are easily disrupted, leading to high attrition or a lack real-time information to commanders.[117] Similarly, UAVs have not been observed to be employed as data or communications nodes or to establish battlefield networks. The author also notes the reliance on commercially available UAVs or low-tech and low-quality systems has led to high attrition. This reveals a preference for dedicated military systems capable of employing high tech systems to network and integrate with other branches or services capabilities in order to effectively conduct joint multi-domain operations. Similarly, different authors have emphasized Ukrainian success at leveraging "NATO technical reconnaissance capabilities" to monitor Russian radio communications for anomalies, use radio direction finding to dispatch smaller UAVs to target areas, and then guide strikes against these targets, suggesting that these authors also place high value on strategic-level military ISR systems.[118]

CONCLUSION

In summary, the articles evaluated for this paper reveal various operational concepts that employ UAVs to support ISR-T and communications in multiple domains. Authors affiliated with the PLA and defense industrial base analyze the benefits and challenges associated with UAV integration and often discuss foreign militaries' experiences employing UAVs in combat. These authors believe that UAVs' ability to generate ISR and targeting quality information will enable more efficient and effective operations in and across domains. By providing larger quantities of timely and accurate ISR and targeting data, UAVs enable operations to secure and monitor friendly maneuver, support the secure transmission of data, and assist in cognitive domain operations. These capabilities will allow the PLA to close kill-chains faster, plan faster, and react quickly on the battlefield. Additionally, UAVs have the potential to enable cross-domain joint operations; however, authors expressed continued dissatisfaction with the level of joint integration of un-crewed capabilities at present.

The PLA has made great strides in integrating unmanned systems into its concepts of operations across domains and levels of conflict. However, many of the more advanced concepts that rely upon advanced levels of joint integration still appear out of the PLA's reach. The predominance of articles identified for this paper discuss employment concepts within a single Service or domain, suggesting that joint integration of UAVs is still nascent. PLA-affiliated articles that do discuss joint concepts do so in the context of discussing developing concepts, such as "multi-modal integrated operations" (体系联动式作战).[119] Additionally, concerns outlined by PLA-affiliated authors of the performance of more advanced target recognition capabilities for close-in reconnaissance based on smaller, expendable systems indicates that more advanced capabilities still might not be ready for contested conditions with a technologically advanced adversary. While the PLA may seek to establish battlefield information dominance to set conditions for kinetic operations, recognition that it must be able to operate UAVs without position, navigation, and timing (PNT) data, free access to networks, or functioning data links indicates a realistic expectation that the PLA will only be able to establish dominance temporarily and that the PLA must develop systems to function without such infrastructure.[120]

Immature technologies and warfighting systems integration are critical impediments that the PLA must overcome for a variety of reasons, but it is unclear how uniform the PLA's progress has been on integrating these platforms in combined arms efforts or cross-domain joint operations. The PLA appears more capable of and possibly inclined to technical solutions for overcoming its cultural command biases, as evidenced by the development of a variety of command information systems, the speed at which the PLA can field new platforms, and high-level leader's continued dissatisfaction with the quality of PLA personnel.

The PLA's reliance on technical solutions creates the potential vulnerability of interference or defeat of the technical solutions central to operational success. UAVs are an important data source that will feed into algorithm-based planning and execution under both informationized and intelligentized conditions; interruption and manipulation of this data feed could have serious impact on PLA operations. PLA authors are already concerned by the possibility that an adversary could feed false data into PLA algorithmic planning systems.[121] Such a scenario might involve measures to deliver false data into the PLA planning this system, accompanied by efforts to simultaneously degrade or disrupt other elements of UAV enabled kill-chains and eventual kill webs. Forcing the PLA to rely on its built-in redundancy and progressively rely on secondary or tertiary means of communications and ISR would enable false information to be fed to the PLA sensing grid more convincingly. Efforts to disrupt sensors and their ability to communicate securely and effectively at range could impact PLA counter-intervention operations. Even if these efforts are minimally effective, they could force the PLA to attempt to rely on cross-domain uncrewed joint enablers, which PLA authors have identified as a deficient capability. To compete and remain prepared to defeat a potential great power conflict, the U.S. military must continuously develop threat-informed counters to the PLA's growing UAV-enabled ISR and strike capabilities. These counters must include not only our own technical solutions, like high-end cyber and electronic warfare programs, but also tactical concepts, such as TTPs for camouflage, concealment, and deception to assist in the generation of false or misleading intelligence.

During collection of the articles cited in this paper, an interesting gap in the literature appeared. While authors affiliated with the PLA Air Force have some of the largest authorship collected, their authorship is concentrated in fewer publications and is more focused on electronic warfare, with a few outliers. This publication pattern could be due to a variety of factors. First, because the PLAA is the largest branch and dominates Central Military Commission organizations, it probably draws on a higher pool of authorship. Second, the scope of this paper does not include articles examining future concepts like swarm and manned-unmanned teaming. Third, the PLAAF is more restrictive regarding what its service members are allowed to publish publically. Fourth, increasing restrictions on sources available outside of China likely limited accessible publications. Fifth, PLAAF authors who publish related articles focus more on simulation methodology, a highly technical publication type that does not always contain relevant or useful insights into systems' employment.

Future research could refine the details of the missions identified in this paper. Other than articles exploring developmental methods for integrating artificial intelligence and machine learning (AI/ML), the details of which fall outside of the scope of this paper, the articles analyzed for this report did not reveal specifics regarding the tasking, collection, processing, exploitation, and dissemination process underlying UAV operations. Similarly, articles lacked specificity regarding information flow and kill-chain decision-making authorities. Clearly defining these processes would significantly enhance our understanding of PLA UAV operations.

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