A Holistic Approach to Intelligence, Surveillance, and Reconnaissance

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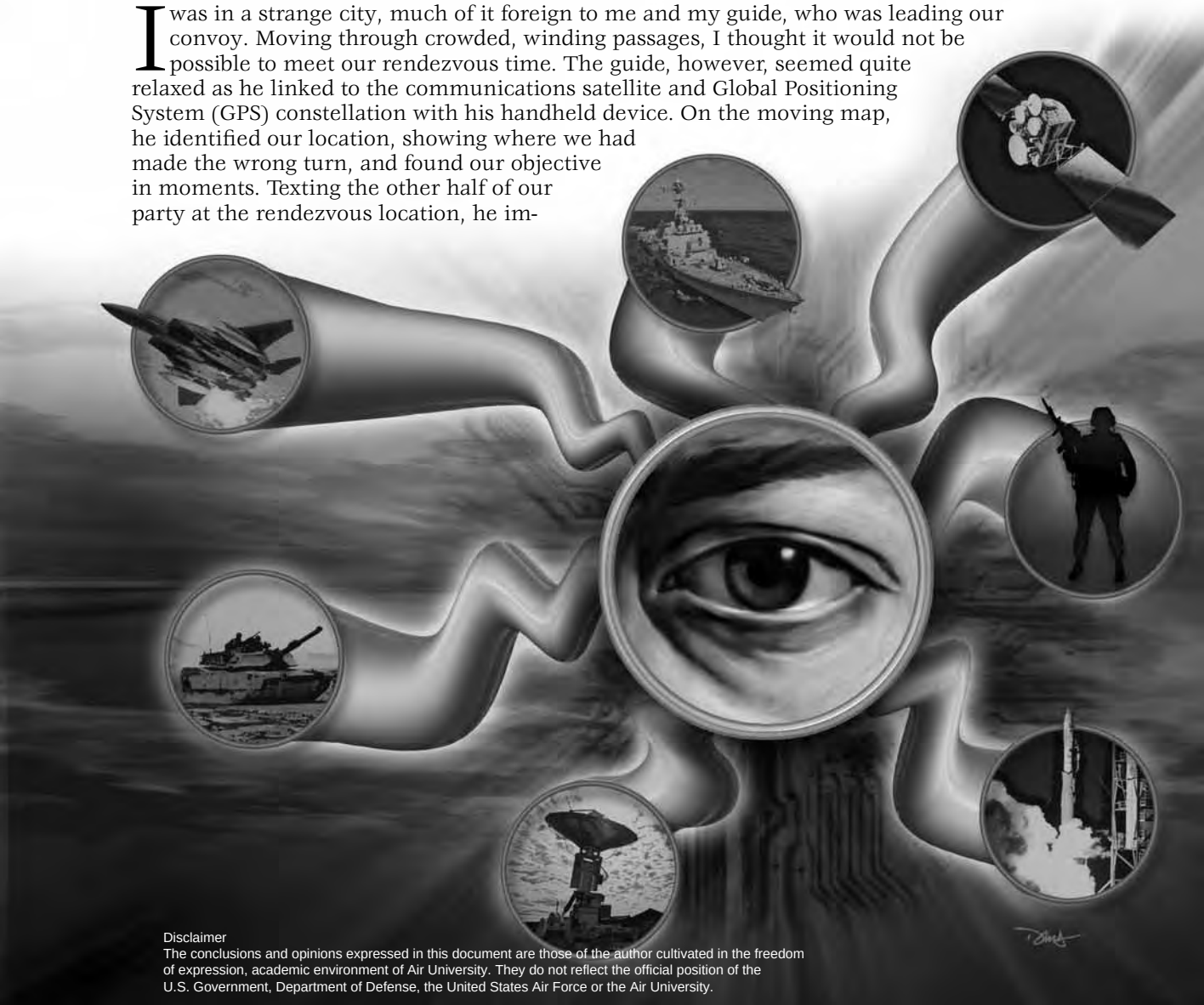
I was in a strange city, much of it foreign to me and my guide, who was leading our convoy. Moving through crowded, winding passages, I thought it would not be possible to meet our rendezvous time. The guide, however, seemed quite relaxed as he linked to the communications satellite and Global Positioning System (GPS) constellation with his handheld device. On the moving map, he identified our location, showing where we had made the wrong turn, and found our objective in moments. Texting the other half of our party at the rendezvous location, he im-



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mediately established a new meeting time. Then, pulling in the latest video feeds on the same device, my guide confirmed that the planned route was clear. Another vehicle joined our convoy en route, and we rendezvoused silently as the GPS device updated both of our locations in real time on the moving map. As we neared our destination, he used the same handheld device to check the latest intelligence postings for the area, noting that his buddy had been here a couple of days ago. His friend had left a posting, warning him to avoid the place on the corner across from our destination, and had marked several other postings showing not only shops with helpful owners but also places to avoid. I was amazed at the amount of data available at his fingertips, easily accessible in near real time.

Of course, all of this transpired on his smartphone, and we were merely trying to maneuver three cars across Boston to meet some friends at a local restaurant. Nevertheless, I was struck by the seamless integration of multiple forms of what I termed intelligence (but what my civilian friends called common information). Starting with several independent applications, they easily integrated full-motion video (FMV), human intelligence (HUMINT), signals intelligence (SIGINT), and communications into a single, intuitive device with a common display—a feat that many people in the military would envy.[1] That amount of information, shared so easily and constructively, made me wonder what it would take to provide the same kind of integration for our forward-deployed forces. What prevents us from developing an intuitive program that would allow the user, a Soldier on the battlefield, to acquire needed information?

To do so, we must treat intelligence, surveillance, and reconnaissance (ISR) holistically. The Department of Defense (DOD) should empower a single agency to address the development and deployment of new technology, consider the overall architecture and standards, examine service culture as it relates to ISR, and work with partner nations to advance their ISR capabilities in a manner that augments the overall intelligence picture. These actions can improve our ISR posture and position us to better incorporate developing technology as new sensors, processing equipment, storage devices, and means of dissemination become available.

Background

One of the most common questions heard at senior levels in the military is, Why is ISR still a high-demand, low-density capability after several years of needing it? We have done much to boost the number and quality of assets in combat, such as flying more sorties on the battlefield and standing up the ISR Task Force within the DOD to expedite the fielding of ISR platforms and sensors. Since 2009 the number of ISR sorties in Afghanistan alone has quadrupled, and in just the last year the Air Force has fielded wide-area surveillance systems such as Gorgon Stare that represent a leap forward in technology, taking ISR from the proverbial "looking through the soda straw" to maintaining surveillance across an entire city.[2] The Air Force has even developed an independent training pipeline for operators of remotely piloted aircraft to help address the demand for their surveillance platforms. Despite this effort, the Air Force still cannot meet the demand.[3]

The service is addressing the imminently correctable shortage of physical assets even if the results are not as forthcoming as many would like. Issues include the development of better sensors, fusion of multiple forms of intelligence into an integrated picture, automation of analysis, expansion of bandwidth, and storage of data. Granted, these efforts entail technological difficulty, but much of the work is already under way and reflects significant progress.[4] The ISR Task Force has cut through much of the bureaucratic red tape, rapidly fielding programs such as the MC-12 Liberty aircraft for manned ISR and helping to expedite the introduction of Gorgon Stare wide-area video surveillance to the battlefield.[5]

Remotely piloted ISR assets will continue as one of the primary tools employed by the international community, as seen in the re-

cent unrest in Libya during which Predator aircraft have conducted both ISR and air strikes.[6] The North Atlantic Treaty Organization considers remotely piloted ISR a critical component of its efforts in the ungoverned regions of Pakistan, having conducted 117 attacks in 2010—more than in any other year.[7]

Even beyond the current usage of ISR, we will experience greater demand to help track fleeting targets. Already in the counterterrorism manhunt, we've had difficulty tracking targets as they hide within the noise of society. Identifying terrorists or collaborators and then tracking them to fix their location will continue to represent the most difficult challenge to any nation that attempts to counter terrorism—and ISR is crucial to this effort.[8] Finding and tracking other types of fleeting targets such as mobile missile launchers or submarines will also amplify the demand for information generated by ISR assets.[9] The real effort here will not involve gathering the data so much as coordinating across multiple sources and domains to display information on a usable, real-time interface that allows us to observe a target continuously from one asset to another without blinking. In short, not creating but bringing many eyes together to form a coherent picture is our challenge.

Current demand has already flooded the skies with aircraft and, more critically, the communications links and intelligence analysts with data.[10] Indeed, we now have a secondary problem—too much data. Inundated with information, our forces either cannot sift through it all to discern key elements or find themselves overwhelmed with irrelevant data that does not directly support the needs of war fighters on the ground.[11] Having more information than we can distribute and use effectively is quickly becoming more problematic than creating more and better ISR platforms and sensors since we cannot productively utilize the data they collect from signals, FMV, and bandwidth-consuming radar images. Several projects in development, however, seek to process data on board the ISR platform itself, which would limit the amount of bandwidth required for transmission and reduce the quantity of raw information delivered to analysts for conversion into intelligence. In short, significant improvements now in progress or on the horizon are addressing the problem of technology as a limiting factor in the exploitation of ISR data.[12]

The fact is, the creation of DOD policy and enforcement of standards do not match the pace at which technology is advancing. This lag in policy prevents us from fully exploiting current and developing technology, creating a situation in which technology drives policy instead of vice versa. Although the DOD is in a hurry to move new technology to the fight, it has not fully addressed the formation of better policy and reorganization to accommodate the growth of ISR.[13] By taking certain steps, the department can keep policy ahead of technology and shape the development of ISR assets instead of simply reacting to the emergence of new technology.

Common Architecture

Among other critical elements, the common architecture that underlies the system allowed my young guide in Boston to bring several pieces of information together on his smartphone. He was able to choose from several specific applications to create a system of information management that gathered the information he needed and presented it in an easily digestible form. In the smartphone market, Apple and Android represent the only two major systems. The fact that anyone who wants to devise an application does not have to create a separate set of standards or communication protocols allows for rapid, cheap development and focuses competition. Smaller applications that solve discrete problems can then be aggregated as needed to enable greater information sharing and exploitation. We need something similar for the ISR community. Currently the ability to communicate and pass information between assets exists, but a common architecture that allows plug-and-play integration does not. An overarching architecture outlining common standards, metadata tagging (simply defined as

"data describing data," simplified information that documents what the stored data contains, enabling easier search and retrieval), connectivity, and processing elements would allow the introduction of new sensors without requiring new operating systems, user interfaces, or protocols to permit communication with other assets currently in use. The lack of common standards and protocols produces inefficiencies within the ISR community; consequently, the inadequate sharing of data results in a lack of information to the war fighter, which in turn creates a false demand signal for more ISR assets.[14] The Government Accountability Office has often cited the need to develop common sensors and platforms that accommodate a plug-and-play concept which facilitates the interchanging of sensors, regardless of manufacturer or platform; this would also provide a framework for the development of new sensors that would not demand proprietary equipment.[15] Additionally, the Air Force has a goal of creating modular plug-and-play payloads with standard interfaces across platforms.[16] Arguably the most important element of our current ISR shortcomings is developing the architecture.[17]

Furthermore, we must ensure that the information from multiple types of sensors—including FMV, radar returns, and signals intelligence—is integrated as well as tagged with the minimum metadata, such as time and location.[18] Today not all data is tagged even with basic metadata, thus leaving it useless for anything other than immediate tactical applications.[19] Simply tagging the information would form the basis of a recallable library. Despite considerable work toward integrating FMV data and ensuring compatibility, we have done little to incorporate either SIGINT or radar data—critical pieces to developing a complete ISR picture.[20] As other forms of information are integrated into a common picture, adding a baseline of certainty to the metadata will improve its utility to both analysts and users in the field. For example, SIGINT or radar information may only reveal the presence of the target in a building, on the roof, or merely at a location nearby. However, by incorporating the level of certainty of target location into the metadata, the end users will have a better understanding of the ambiguity of the information and can use it appropriately when correlating multiple sources of target information.[21] This baseline tagging of information would provide the foundation for pulling these currently disparate data streams together and overlaying them onto a common picture. Bringing video, radar, and SIGINT together into an easily digestible display would allow greater situational awareness to command and control elements as well as enable us to rapidly track and fix fleeting targets. Moreover, it would permit virtual time travel; that is, video surveillance of a meeting between two vehicles might not trigger any action or even be noticed, but the video would be coded with time and location. Later, after other sources, possibly HUMINT or SIGINT, correlate one vehicle as a known target, the video could be rewound to the original meeting. With wide-area surveillance, both targets would be recorded, and the analysts could then track both vehicles as they fast-forward the data to real time, thereby locating them. From there, we could continue tracking or strike, as required. Fully compatible forms of intelligence that come in with common metadata dramatically reduce the time spent correlating and displaying the data to build a common picture. Such correlation is possible now, but it demands a significant effort in manpower and assets and is therefore reserved only for high-level targets such as Abu Musab al-Zarqawi in Iraq.

Beyond the common architecture, we must solve several technical issues, such as the overwhelming requirement for data storage and the increasing demand for bandwidth. However, we have no reason to believe that technology will not continue to progress and eventually solve these problems. In the meantime, we should establish an overarching architecture to guide this development and assure the integration and easy presentation of data; otherwise, it will have only limited usefulness, even if the other issues are resolved. In addition to interoperability and ease of sharing, a com-

mon architecture will reduce costs by combining redundant programs, decrease the amount of money and effort put toward the production of proprietary systems, and facilitate the development of software to share data more efficiently and effectively. By creating a common architecture to enable a smartphone-type interface, the military will revolutionize mobile communications, moving from voice to data and transforming World War II–era radio/telephone operators into battlefield information managers.

Establishment of the Architecture

ISR has become not only a critical element to the conduct of operations but also a minimum force requirement.[22] Given the intelligence-intensive nature of both counterinsurgency and counterterrorism, the proliferation of FMV has greatly enabled the effectiveness of US forces. This has led to enormous demand for ISR assets, eventually resulting in former secretary of defense Robert Gates's establishment of the ISR Task Force to speed the development and deployment of ISR platforms for contingency operations. The main priorities of the task force include rapidly fielding and sustaining ISR initiatives; ensuring that adequate processing, exploitation, and dissemination exist; and ensuring that joint and coalition forces can share ISR data.[23] The task force, which has proved quite successful in operating outside the standard Pentagon procurement channels, will become a permanent part of the DOD's Office of the Undersecretary of Defense for Intelligence. In order to proceed in an orderly manner, reduce redundancy, and establish an overall framework for data sharing, the DOD needs to expand the task force's charter and empower it to bring together current guidance and standards, define a single vision for ISR that will articulate its operational use, and form the strategic architecture to provide for future growth.

Establishing the ISR Task Force as a permanent organization is a step in the right direction toward empowering it to act beyond its initial charter and set the vision for ISR development across services, creating guidelines that will become an overall architecture for ISR data sharing. Rather than merely rushing more assets to the theater, having the task force define what ISR should do and how it should fit into the overall future of operations from the DOD level could produce synergistic effects. This will help industry and research institutes focus their efforts and improve productivity. The task force can also help enforce a common set of existing standards and require the compatibility of information for sharing. This function of the task force would prove especially valuable in terms of taking advantage of numerous platforms already in existence by efficiently fusing various types of data collected from radar returns, SIGINT, and FMV to offer a common picture.[24] By having a common database and architecture, we can write the software and applications that meet the ultimate goal of allowing Soldiers in the field to pull or request information in usable form and tailor it to their requirements.[25] Giving the ISR Task Force the authority and budget to generate the overall architecture that will push information to the operational level constitutes a crucial next step.

Because ISR is incorporated into joint concepts such as AirSea Battle that will further drive demand for integrated ISR, the task force would be the natural choice for supplying the overarching guidance. AirSea Battle will rely on integrating Air Force and Navy assets, of which ISR is a key component.[26] This particular joint concept also highlights the need to look beyond the traditional domains of air and space for ISR. Remotely operated ISR platforms for underwater surveillance, now in development, will track submarines, give us time-critical offshore strike capability, and place stay-behind devices that can monitor traffic through strategic choke points.[27] These assets allow access to denied areas or those that pose unacceptable risks to manned ships (such as shallow or mined waters). Again, to build a common picture with a truly unblinking eye, we must bring such platforms—as well as land-based stay-behind devices for monitoring roads,

compounds, or other high-interest areas—into the same architecture and planning system. At present there is little integration of remotely piloted aircraft, underwater vehicles, and other stay-behind devices because of the lack of overlap and the overwhelming amount of data.[28] However, as the ISR field develops and more information from various domains becomes available, we will rely on the integration of information driven by common standards and an overarching architecture to compile a usable database that brings together and displays both real-time and historical information.

Cultural Change

Culture is one of the obstacles to fully exploiting the data gathered by ISR assets. Many individuals and organizations have not fully kept up with the rapid shift in data sharing, distribution, and ways of thinking about and treating information. As we saw in the scenario that opened this article, a 20-year-old has a vastly different relationship with, and expectation of, technology than people just a generation older. Rapid changes in information technology have altered the paradigm of experience. No longer does experience necessarily equate to knowledge when it comes to employing information technology. The military needs to embrace emerging technology culturally, engage with the younger generation, and change how it looks at intelligence and ISR by fully incorporating intelligence into operations.[29]

The most urgently needed cultural shift is the fusion of operations and intelligence, two functions that we can no longer consider separate entities that work independently. The special operations community has fused these two functions to great effect in the counterterrorism effort, with ISR a critical component of operationalizing intelligence.[30] The cultural shift is beginning to take place within the services as well, as evident in the Navy's merging of the intelligence and command and control career fields.[31] The Air Force has also addressed the rising importance of ISR by creating the Office of the Deputy Chief of Staff for Intelligence, Surveillance, and Reconnaissance in 2006 to manage the service's ISR effort. This position has helped expedite the fielding of new technology and has pushed a cultural shift within the Air Force to integrate operations and intelligence as well as operationalize the employment of ISR.[32] A significant cultural shift is already occurring, especially within the intelligence community, but it needs to be institutionalized and expanded within the Air Force.[33] Intelligence is no longer solely a support function. Often, the purpose of a mission is to gather information, develop patterns of life, and locate targets. We can take additional steps to further the integration of operations and intelligence and thereby fully exploit the data collected by ISR platforms by giving intelligence the operational assets to develop real-time intelligence. For instance, the Air Force can put ISR on par with its strike and mobility assets by forming a major command responsible for ISR and making intelligence and data sharing an operational function. Such an agency already exists and has much of the structure needed for success. The Air Force ISR Agency is a two-star command within Air Combat Command (ACC), but as a subordinate unit, it is often overlooked when ACC faces more pressing issues such as bringing on two new platforms—the F-22 and F-35. The fact that much of the infrastructure for a major command exists within the agency would limit the costs and personnel necessary to establish a smaller two-star headquarters similar to Air Force Special Operations Command.

A separate ISR command would highlight the Air Force's commitment to ISR and lead its development, integration, and operations within the DOD. We could then present ISR as a cross-domain capability including both operational assets and multi-intelligence capabilities. Intelligence would take on an operational focus so that the command would have the purpose of managing operational intelligence gathering. This command would be able to prioritize ISR and the development of the technology as well as the organization, dissemination, and fusion of intelligence with operations. Intelligence would

support other ongoing operations and targeting efforts, and the gathering of intelligence would be an operational goal in and of itself. Having its own command would allow the development of an ISR culture outside ACC—one that would fully exploit ISR capabilities and operationalize intelligence for use across the services.[34] Also, an ISR command would serve as the single voice for ISR issues and present a unified vision for the future of Air Force ISR—something currently missing.[35] Furthermore, this command could become the basis for future development of a larger command that encompasses intelligence and both airborne and space-based ISR platforms, thus creating a cross-domain organization that leverages the synergy among operations, intelligence, and eventually communications; it would also speak to the combatant commands as a single voice for Air Force ISR.

Additionally, we should view ISR as a sharable asset that is prioritized and allocated. Because we often cannot task assets outside the owning agency, they are not fully utilized.[36] Empowering the ISR Task Force enables it to oversee the full employment of ISR assets, maximizing the number of sensors and platforms in use. By centralizing the allocation of limited ISR assets, we can utilize the optimal number of them, resulting in increased utilization rates and intelligence value of collected data. Doing so would mean that some units and organizations that can currently access ISR assets would have to change their culture and thus help blend operations and intelligence.[37]

Building a Partner Nation Network

The United States should use its position of information preeminence to help build relationships with our partner nations and develop their ISR capabilities. The *Quadrennial Defense Review Report* notes that both ISR and capable partner nations are critical to the new security environment.[38] Although the report mentions that investments in airborne ISR will contribute to US capacity for security force assistance missions, it does not emphasize the key role that ISR can play in building partner nation capacity and improving relations with those countries.[39]

As a relatively reliable and affordable means of enhancing existing ground and air forces, ISR presents partnership opportunities to nations that wish to improve their capabilities in this area. The 6th Special Operations Squadron, whose primary mission is to train foreign air forces, is rapidly building an ISR training capability; furthermore, Air Force Special Operations Command is looking at ways to build a modular ISR training program around relatively cheap, light fixed-wing aircraft that we can easily export to partner nations. These aircraft are fairly reliable, readily available, and easily maintained and flown. A relatively small investment in equipment and training can produce a robust, sustainable means of augmenting a partner's capability, not only that of its air force but also that of its ground forces and intelligence apparatus. (Improving intelligence is especially attractive to nations involved in countering terrorists or conducting counterinsurgencies.)

In order to meet the demand for ISR, the Air Force should look at both exporting older equipment and developing a program that will meet partner nations' needs, based on an analysis of their intelligence requirements and capabilities.[40] Such a tailored ISR program for addressing these countries' shortfalls can include manned and remotely piloted systems as well as old and new equipment, including SIGINT and other technical intelligence.[41] A key component would involve the ability to tie their intelligence into the US system to take advantage of the data gathered and the partner nation's analysis of that data, which, of course, would have the advantage of familiarity with the local culture and current security situation. Despite the many issues that accompany the sharing of intelligence and technology, we still have an opportunity to take advantage of partner nations' expertise and gain intelligence from areas that would otherwise go unexplored while at the same time reduce the US footprint involved in collecting this information.

Building our partners' ISR capabilities gives us a chance to establish continuous engagement with their forces in an operational environment by employing ISR platforms and interacting with intelligence officers. By developing an intelligence-sharing relationship, we can cultivate a more enduring engagement than the current episodic one.[42] Doing so requires development of force structure to engage in US Security Force Assistance to train, advise, and equip partner nations to conduct airborne ISR and SIGINT as well as integrate the data to create usable intelligence.[43] These interactions will create exchange opportunities for both operations and intelligence officers to immerse themselves in a foreign culture and move from merely gathering data to acquiring knowledge, building trust, and, eventually, understanding the culture, ideas, and sociology that affect decision making in relevant populations. Ultimately the relationships and understanding that come from working with such countries are the key to producing usable intelligence and increasing the effectiveness of our counterterrorism and counterinsurgency operations, with the goal of developing an intelligence strategy that intertwines with and supports the operational strategy.[44]

Conclusion

We can make changes now that will maximize the available ISR infrastructure within current technological and budgetary constraints.[45] Indeed, we can still make significant progress as we wait for additional technology to develop and create a better environment for the addition of new platforms and sensors. The largely unaddressed issues that will allow further exploitation of ISR both now and in the future include the following:

- Empowering the ISR Task Force to set the vision for ISR and defining the capabilities that the DOD wants from ISR
- Establishing an overarching architecture that addresses ISR across all domains
- Enforcing established standards to attach basic metadata to all ISR products, including FMV, SIGINT, and radar images
- Addressing the cultural change required to integrate operations and intelligence and keep ahead of the rapid pace of technology and information
- Establishing an ISR major command within the Air Force to address ISR as a separate function
- Developing an ISR network with partner nations

Empowering an organization to set the vision for ISR across all domains will reduce redundancy, improve interoperability, keep the services moving forward in concert, and ease the shift in culture to fully exploit information technology.

We still need more sensors and platforms to meet the demand for information, but without a means to incorporate the data that they produce into a common database easily shared with user-friendly, customizable displays, we will reach a point of diminishing returns and values. It is critical that we develop a flexible architecture with standards, structure, and commonality to exploit the data currently available and that we have the ability to incorporate new technology seamlessly. Even if they are not perfect, a vision and an organization to keep the DOD moving toward that goal will go a long way to improving the access to and processing of ISR data. Instead of reacting to new technology and letting it drive policy, the DOD needs to have a coordinated effort for guiding the development of technology and exploiting ISR's capabilities to better meet future requirements. ISR has become too critical to the way we fight for us to do otherwise.

By treating ISR holistically, we can address the development of new technology as well as the overall architecture and standards, look at service culture as it relates to ISR, and work with partner nations to advance their ISR capabilities in a manner that augments the overall intelligence picture. Empowering a single agency to set a common vision and

take charge of ISR will substantially improve both the effectiveness and efficiency of that capability. Furthermore, by taking such actions as making the Air Force ISR Agency a major command, we can create organizations within the services to fully address ISR issues and integrate operations and intelligence. As technology continues to advance rapidly, ISR will fuse operations and intelligence in a way few other mediums can, thereby paving the way for the development, processing, and execution of actionable intelligence by the same asset. Again, rather than simply react to future developments, it is imperative that the DOD be ready to guide the many aspects of ISR in concert. ✪

Notes

1. These applications include Google Maps, Traffic Boston, foursquare, and Yelp. Though not tailored to intelligence, they do provide a great deal of information that can be combined to generate a clear picture of what is in the area. Foursquare uses the signal from a cell phone to send its location to a central database that then makes it available to others. Many traffic sites allow the transmission of real-time video from cameras in several major cities as well as other camera applications that show surf conditions, the weather, or scenic views. Applications such as Yelp let users leave ratings and commentary on local businesses that others can access in real time via GPS signal, based on their position. So simple a thing as a person's location opens up a wealth of instantly available information that can easily be overlaid onto a single map.

2. Ellen Nakashima and Craig Whitlock, "With Air Force's Gorgon Drone 'We Can See Everything,'" *Washington Post*, 2 January 2011.

3. Ibid.

4. Brig Gen Dale Waters, USAF, retired (Defense Advanced Research Projects Agency), interview by the author, 19 January 2011.

5. Nakashima and Whitlock, "Air Force's Gorgon Drone."

6. Martha Raddatz and Kirit Radia, "Pentagon Confirms First Predator Drone Strike in Libya," *ABC World News*, 23 April 2011, http://abcnews.go.com/International/pentagon-confirms-predator-drone-strike-libya/story?id=13442570; and "U.S. Authorizes Drone Strikes in Libya, McCain Visits Opposition in Benghazi," *PBS Newshour*, 22 April 2011, http://www.pbs.org/newshour/rundown/2011/04/syria-beefs-up-security-for-protests-mccain-visits-libya-rebels.html.

7. Eric Schmitt, "New C.I.A. Drone Attack Draws Rebuke from Pakistan," *New York Times*, 13 April 2011, http://www.nytimes.com/2011/04/14/world/asia/14pakistan.html. Note that some sources put the total number of strikes at 118. See, for example, "The Year of the Drone: An Analysis of U.S. Drone Strikes in Pakistan, 2004–2011," New America Foundation, accessed 12 October 2011, http://counterterrorism.newamerica.net/drones.

8. Michael T. Flynn, Rich Juergens, and Thomas L. Cantrell, "Employing ISR: SOF Best Practices," *Joint Force Quarterly* 50 (3d Quarter 2008): 56–61, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA516799. The integration of operations and intelligence has transformed the ability of our forces to hunt terrorists and find fleeting targets. Moreover, the integration of FMV has become an integral part of operations and critical to both the development and prosecution of targets. Accounts such as the killing of Abu Musab al-Zarqawi, which reflect the successful fusion of operations and intelligence with the integration of ISR assets, are well known. The hundreds of hours of ISR development that led to the killing of Iraq's most notorious terrorist leader and the subsequent dismantling of his network were only one part of the process. The integration of ISR into an all-source intelligence system and into operations allowed us to prosecute these targets.

9. Rebecca Grant, "U.S. Needs to Deter China's Mobile Missile Launchers," UPI.com, 25 March 2009, http://www.upi.com/Top_News/Analysis/Outside-View/2009/03/25/US-needs-to-deter-Chinas-mobile-missile-launchers/UPI-75531237999938.

10. Stew Magnuson, "Military 'Swimming in Sensors and Drowning in Data,'" *National Defense*, January 2010, http://www.nationaldefensemagazine.org/archive/2010/January/Pages/Military%E2%80%98SwimmingInSensorsandDrowninginData%E2%80%99.aspx.

11. Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Report of the Joint Defense Science Board / Intelligence Science Board Task Force on Integrating Sensor-Collected Intelligence* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, November 2008).

12. Mark Luettgen, PhD (president, Systems and Technology Research), interview by the author, 12 February 2011.

13. Maj Gen Blair Hansen (deputy commander, Joint Functional Component Command for Intelligence, Surveillance, and Reconnaissance), interview by the author, 2 March 2011.

14. US Government Accountability Office, *Intelligence, Surveillance, and Reconnaissance: Overarching Guidance Is Needed to Advance Information Sharing*, GAO-10-500T (Washington, DC: GAO, 17 March 2010), http://www.gao.gov/new.items/d10500t.pdf. This document indicates that standards are not being evenly applied across ISR programs, resulting in inefficiencies: "It is not clear how much of the collected data are not being shared. Until DOD identifies what types of ISR information should be shared and assigns priorities for sharing data, it is unclear whether mission-critical information will be available to the warfighter. In addition, the inability of users to fully access existing information in a timely manner is a contributing factor to the increasing demand for additional ISR collection assets" (9).

15. US Government Accountability Office, *Defense Acquisitions: Opportunities Exist to Achieve Greater Commonality and Efficiencies among Unmanned Aircraft Systems*, GAO-09-520 (Washington, DC: GAO, July 2009), http://www.gao.gov/new.items/d09520.pdf. See also US Government Accountability Office, *Intelligence, Surveillance, and Reconnaissance*.

16. US Air Force, *United States Air Force Unmanned Aircraft Systems Flight Plan, 2009–2047* (Washington, DC: Headquarters US Air Force, 18 May 2009), http://www.dtic.mil/cgi-bin/GetTRDoc?AD = ADA505168&Location = U2&doc = GetTRDoc.pdf.

17. "The architecture and compatibility piece is huge. The more I get involved in the details of the ISR business the more I find things that don't talk to other things. All the solutions appear to be just 2–3 years off, but like a mirage the 2–3 years keep sliding to the right." Konrad Trautman, director of intelligence, US Special Operations Command, to the author, e-mail, 12 May 2011.

18. Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Integrating Sensor-Collected Intelligence*, 63.

19. US Government Accountability Office, *Intelligence, Surveillance, and Reconnaissance*.

20. Luettgen, interview; and Hansen, interview.

21. "A measure of certainty is important to enabling humans and automated processing to combine information across different sources. Uncertainty could be as simple as a CEP [circular error probable] 50 number for the location data, or it could be a list of possible identifiers for an object with probabilities for each (e.g., human 60 percent, vehicle 10 percent, animal 30 percent), or it could be something more complex if the underlying data is more complex. Many modern systems (e.g., next-generation GMTI [ground moving target indicator] radars and the next increment of Gorgon Stare) can detect multiple types of objects simultaneously (humans, vehicles, animals), and there is often ambiguity in what has been detected. Also, with increasingly accurate terrain models, the location ambiguity becomes more complex (e.g., in radar or signals intelligence, it may not be apparent if the target is on a building roof, or inside, or on the ground), but it would be valuable to understand the nature of the ambiguity to facilitate correlation with video. We need ISR data sources to adhere to standard uncertainty representations in the same way that they do for other data and metadata to enable consistency of interpretation and simplified integration of new capabilities, which again points to the need for DOD-wide coordination." Luettgen, interview.

22. P. W. Singer, *Wired for War: The Robotics Revolution and Conflict in the Twenty-First Century* (New York: Penguin Press, 2009), 216–17.

23. Harrison Donnelly, "ISR LEADER: Ensuring Warfighters Have the Intelligence Support They Require," *Geospatial Intelligence Forum*, September 2010, http://integrator.hanscom.af.mil/2010/September/09232010/09232010-15.htm.

24. Hansen, interview; Luettgen, interview; and John T. Bennett, "Gates' ISR Task Force to Join Top DoD Intel Office," *DefenseNews*, 7 October 2010, http://www.defensenews.com/story.php?i = 4863676.

25. "One of the benefits of the common architecture will be the ability for users to not only pull existing information but to request new information, subject to resource availability and priority. Right now, the ability to request resources is very limited, but the common architecture will make this easier and will allow us to use the assets we have more wisely and responsively to get information to the Soldier on the ground." Luettgen, interview.

26. Jose Carreno et al., "What's New about the AirSea Battle Concept?," US Naval Institute *Proceedings* 136, no. 8 (August 2010), http://www.usni.org/magazines/proceedings/2010-08/whats-new-about-airsea-battle-concept; Greg Grant, "CSBA [Center for Strategic and Budgetary Assessments] AirSea Battle Concept: More Stealth, Long-Range Strike to Counter Chinese Battle Networks," Defense Tech, 18 May 2010, http://defensetech.org/2010/05/18/csba-releases-its-airsea-battle-concept/; Andrew F. Krepinevich, *Why AirSea Battle?* (Washington, DC: Center for Strategic and Budgetary Assessments, 2010), http://www.csbaonline.org/wp-content/uploads/2010/02/2010.02.19-Why-AirSea-Battle.pdf; and Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 2010), 33, http://

www.defense.gov/qdr/QDR%20as%20of%2026JAN10%200700.pdf.

27. Singer, *Wired for War*, 114–16; and Hunter Keeter, "Navy Unveils UUV [Unmanned Undersea Vehicle] Master Plan—New Capabilities, New Vehicle Classes," *Undersea Warfare* 7, no. 3 (Spring 2005), http://www.navy.mil/navydata/cno/n87/usw/issue_26/uuv.html.

28. Paul Geier (chief of RPA/UAS [remotely piloted aircraft / unmanned aircraft system] Interoperability and Future Capabilities, AF/A2CU), interview by the author, 10 March 2011.

29. Hansen, interview.

30. Flynn, Juergens, and Cantrell, "Employing ISR," 56–61.

31. Robert K. Ackerman, "Navy Builds around Intelligence, Information Consolidation," *SIGNAL Magazine*, May 2010, http://www.afcea.org/signal/articles/templates/Signal_Article_Template.asp?articleid=2282&zoneid=254; and Jim Garamone, "Intel, Ops Fusion Aids Warfighters, Roughead Says," American Forces Press Service, 23 March 2011, http://www.defense.gov/news/newsarticle.aspx?id=63278.

32. Lt Gen David Deptula, USAF, retired, interview by the author, 19 January 2011; Rebecca Grant, "Actionable Intelligence: It's the Holy Grail, and the Air Force Is Taking Big Steps toward Getting It," *Air Force Magazine* 90, no. 6 (June 2007): 40–43, http://www.airforce-magazine.com/MagazineArchive/Documents/2007/June%202007/0607intelligence.pdf; and 17th Training Wing Public Affairs, "ISR Leader Passes Torch to New Generation," Air Force Print News Today, 8 October 2010, http://www.af.mil/news/story_print.asp?id=123225750.

33. "ISR Surgeon: Finding and Fixing Enemies and Friends in Theater [interview with Maj Gen Blair E. Hansen, director of ISR capabilities, Air Force]," *Geospatial Intelligence Forum*, July/August 2009, 24, http://www.kmimediagroup.com/files/GIF_7-4.pdf.

34. Dave Majumdar, "F-35 as ISR Collector: Air Combat Command Isn't So Sure," *C4ISR Journal*, 1 November 2010, http://www.c4isrjournal.com/story.php?F=4756598; Deptula, interview; and Hansen, interview.

35. Majumdar, "F-35 as ISR Collector."

36. Deptula, interview; and Hansen, interview.

37. Luettgen, interview.

38. Department of Defense, *Quadrennial Defense Review Report*, 13, 22–23, 28–30.

39. Ibid., 29.

40. Geier, interview.

41. Briefing, Konrad Trautman, director of intelligence, US Special Operations Command, subject: Intelligence Strategies for Persistent Conflict, National Defense Industrial Association, Special Operations, and Low Intensity Conflict, 11 February 2009, http://www.dtic.mil/ndia/2009SOLIC/5Trautman.pdf.

42. Trautman, e-mail.

43. Trautman, briefing.

44. Ibid.

45. These include the cancellation of supporting programs, such as the Transformational Satellite Communications System, that are proving too expensive yet would help increase the bandwidth to transmit greater amounts of data. See Robert M. Gates, "Defense Budget Recommendation Statement" (speech, Arlington, VA, 6 April 2009), http://www.globalsecurity.org/military/library/news/2009/04/dod-speech-090406.htm.

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