# Hurtling Toward Failure
## Complexity in Army Operations

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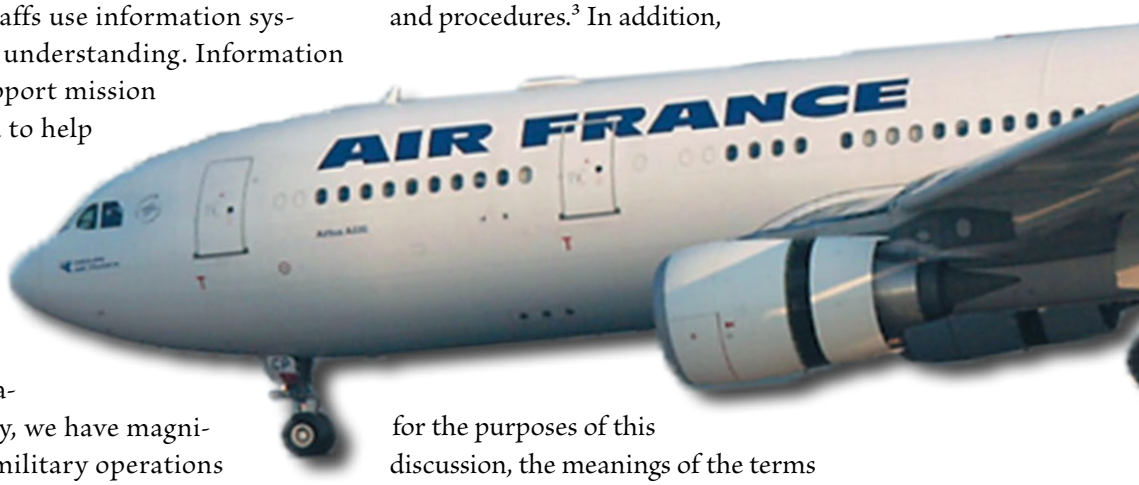
For years, soldiers, military researchers, theorists, and writers have discussed the need for the Army's planning and decision-making models to account for complexity. Army doctrine on *operational art*, for instance, incorporates creative ways to manage military forces effectively as part of complex situations. According to Army Doctrine Reference Publication (ADRP) 3-0, operational art is a cognitive approach to developing strategies, campaigns, and operations that tries to account for the complex relationships between tactical actions and strategic objectives.[1] Commanders and staffs can use this approach to visualize and understand a complex operational environment (OE).

Commanders and staffs use information systems to support shared understanding. Information systems designed to support mission command are supposed to help a commander and staff visualize their OE by collecting, collating, and displaying information. However, in the drive to obtain more and more information through technology, we have magnified the complexity of military operations more than we have improved our ability to understand an OE. The increased complexity—which is of our own making—*increases the risk* of a catastrophic failure during any given mission regardless of a commander's approach to understanding an OE.

### Army Mission Command Systems

This paper describes employment of Army information systems in the context of operational art and the complexity of military operations. The discussion uses the phrase *mission command systems* (plural) as it is commonly used—to refer to the information systems that support mission command. Army doctrine in ADRP 6-0, however, uses the term *mission command system* (singular) to include personnel, networks, information systems, processes and procedures, and facilities and equipment.[2] Doctrinally, an *information system* consists of equipment that collects, processes, stores, displays, and disseminates information. It includes hardware, software, communications, policies and procedures.[3] In addition, for the purposes of this discussion, the meanings of the terms *data* and *information* sometimes overlap.




The mission command systems assembled to support an operation form a complex *system of systems* somewhat similar to the complex information systems used by large commercial aircraft. The commanders of Army operations and the captains of large commercial

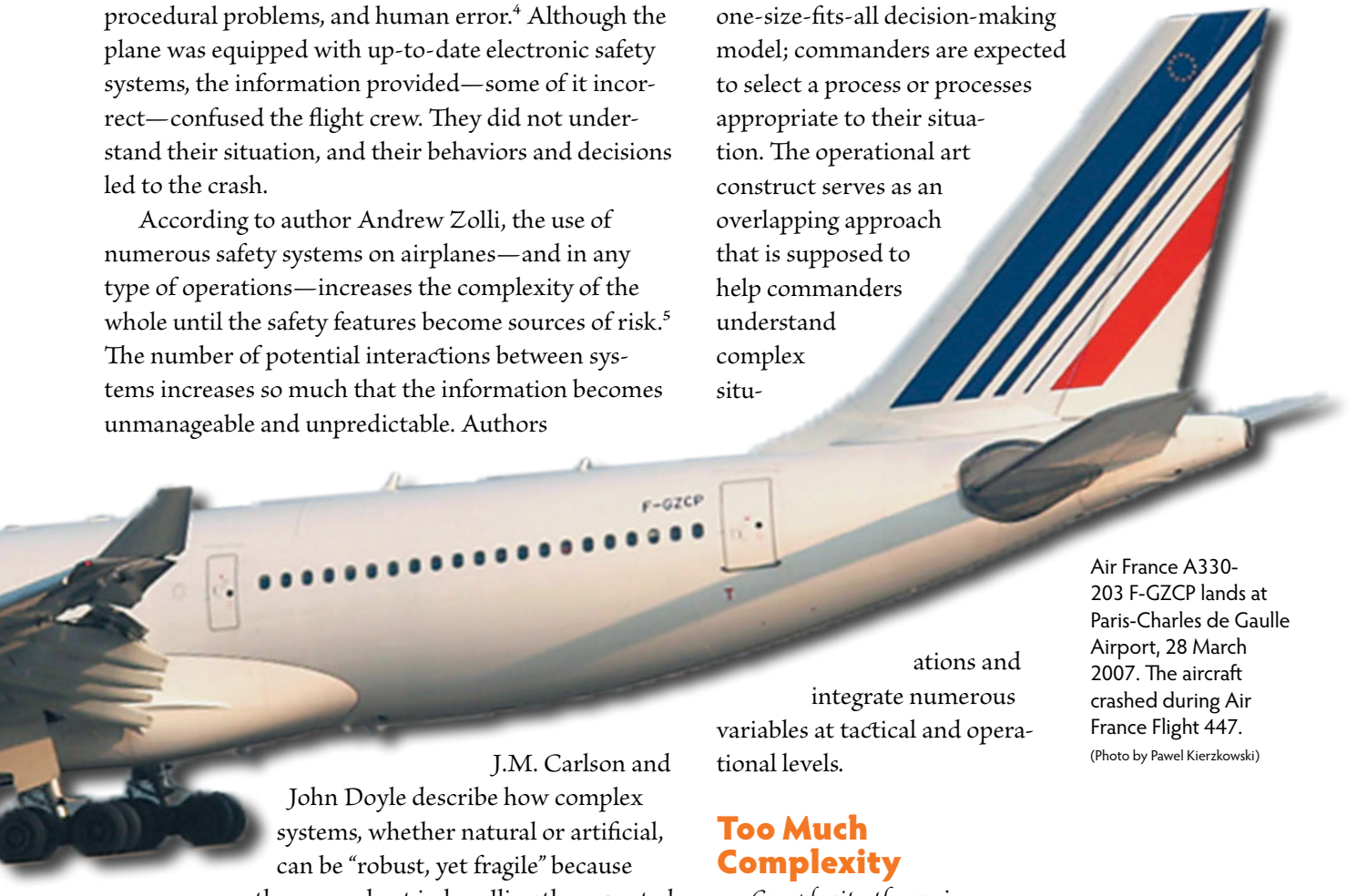
aircraft must manage enormous amounts of data and information provided by their information systems. The Air France (AF) Flight 447 disaster provides a case study of how the complexity arising from information systems intended to support operations can contribute to catastrophic failure.

## Too Much Information

On 1 June 2009, AF 447, from Rio de Janeiro to Paris, crashed into the south Atlantic killing all on board. The final report on the crash, published in 2012, attributed the cause to a series of events and situations that included training deficiencies, equipment failures, procedural problems, and human error.[4] Although the plane was equipped with up-to-date electronic safety systems, the information provided—some of it incorrect—confused the flight crew. They did not understand their situation, and their behaviors and decisions led to the crash.

According to author Andrew Zolli, the use of numerous safety systems on airplanes—and in any type of operations—increases the complexity of the whole until the safety features become sources of risk.[5] The number of potential interactions between systems increases so much that the information becomes unmanageable and unpredictable. Authors J.M. Carlson and John Doyle describe how complex systems, whether natural or artificial, can be "robust, yet fragile" because they are robust in handling the expected, yet fragile when faced with an unexpected scenario, a series of small failures or problems, or a flaw in design, manufacturing, or maintenance.[6]

Ever since Clausewitz described how the friction inherent in war makes even the simplest of tasks difficult, military commanders have desired certainty on the battlefield as a means to achieving victory.[7] Achieving certainty depends partly on acquiring the information needed to make decisions, so it is no surprise that the military has sought to collect data and information in its planning and decision methods. Army doctrine first codified a formal decision–making approach in 1932. Since then the doctrine has evolved considerably, increasing the number of variables as well as the complexity of the processes. The Army now has its *operations process* and subordinate planning processes known as the *Army design methodology*, the *military decision-making process*, and *troop leading procedures*. Operations are considered so complex that doctrine does not claim to provide a one-size-fits-all decision-making model; commanders are expected to select a process or processes appropriate to their situation. The operational art construct serves as an overlapping approach that is supposed to help commanders understand complex situations and integrate numerous variables at tactical and operational levels.




Air France A330-203 F-GZCP lands at Paris-Charles de Gaulle Airport, 28 March 2007. The aircraft crashed during Air France Flight 447. (Photo by Pawel Kierzkowski)

## Too Much Complexity

*Complexity theory* is an umbrella term referring to the study of organizations as complex adaptive systems that must be able to receive and adapt to feedback. In principle, operational art incorporates adaptability. According to

ADRP 3-0, commanders pursue strategic objectives through tactical actions. They combine their "skill, knowledge, experience, and judgment to overcome the ambiguity and intricacies of a complex, ever changing, and uncertain operational environment to better understand the problem or problems at hand. Operational art … integrates ends, ways, and means, while accounting for risk."[8]

**The Air France crew experienced a sudden torrent of information—a sort of data avalanche. … They could not analyze all of it effectively, and they lost their lives.**

Decisions depend on understanding, understanding depends on information, and information depends on data and analysis. As technology has evolved, the Army has explored various means to provide timely and relevant information to the commander and staff. For example, in Vietnam the Army used airborne command and control helicopters.[9] Beginning in the 1980s, the Army began to incorporate information technology and computer networks.

Mission command systems are an amalgamation of computer networks, sensor systems, radio networks, and satellite communications. Recent efforts in the mission command systems community (referring to all developers, users, and stakeholders of Army information systems) have focused on increasing the sensors and collection networks and their horizontal and vertical information sharing. As the systems and networks have grown in size and capacity, they have also grown in complexity. For example, one major system that supports mission command is known as Command Post of the Future (CPOF). This complex computer network comprises over nine subordinate networks each with its own sensor or collection network.[10] One could argue that CPOF is a complex system-of-systems by itself. However, it is only one part of any overall systems architecture in support of mission command—and the systems differ for every mission because every commander selects and employs systems based on the mission.

The complexity introduced by such systems is not limited to their structure. They add to the complexity faced by commanders due to the volume of data and information they provide. The Army routinely uses information systems in experiments, rotations at combat training centers, and real-world operations. In numerous experiments, training events, and operations, data and information inundate the staff and commanders—much of it unimportant, inaccurate, conflicting, or irrelevant. This phenomenon is not unique to the military. Technology blogger Anukool Lakhina discusses concerns about businesses losing key insights in a "big data avalanche" (meaning a rapid or sudden arrival of *big data*) coming from information systems while analytics technology remains inadequate for making the data meaningful.[11] Department of Defense (DOD) and Army networks are greater in size and scope than even the largest corporate computer networks in terms of inputs and nodes. If business leaders worry about this problem, perhaps military leaders should be worried, too, because the military's problem is far bigger.

The Air France crew experienced a sudden torrent of information—a sort of data avalanche. They were unable to make the decisions that might have saved their airplane due, in part, to an overwhelming amount of relevant, irrelevant, conflicting, and inaccurate information. They could not analyze all of it effectively, and they lost their lives. No doubt Army units using information systems intended to support mission command have found themselves in a similar state of paralysis due to excess information.

Proponents of the of Army's mission command systems claim their systems allow units to integrate information vertically and horizontally, share it quickly, and make faster decisions.[12] As championed by Stanley McChrystal, rapid information sharing should help soldiers and leaders at each level develop a holistic understanding, gain key insights, and act decisively on the battlefield.[13] All of this is supposed to reduce uncertainty. McChrystal pioneered ways to improve information sharing during operations, but it was the adaptive leaders trained to receive, process, and act on the

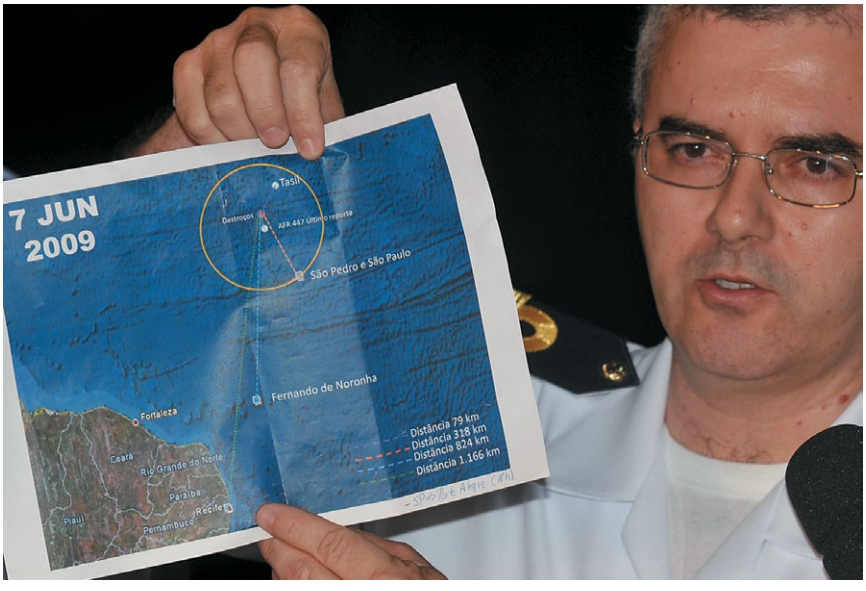
information who made his approach effective. However, the Army has continued to emphasize technology as the solution to uncertainty and therefore has continued to increase *the quantity* of information systems. The approach typically represented by Army lessons learned publications is similar, emphasizing technological solutions over training or leadership solutions.

## Resilient Leaders, Resilient Systems, and Resilient Forces

Military forces need a way to reduce uncertainty without simultaneously increasing complexity. True, they need resilient mission command systems that can enable resilient forces. Resilient systems and resilient forces are adaptable, versatile, and flexible, but adaptability (or adaptation) is the most important characteristic. G. Scott Gorman's statement about adaptable soldiers, penned in 1998, holds true today: "Adaptation, although it may involve technological solutions, does not originate from technology. Adaptation springs from the minds of both leaders and followers."[14] Adaptable leaders and followers need to be able to analyze and interpret information correctly and make rapid decisions repeatedly as information changes or when bits of information seem incongruous. The 2012 *U.S. Army Capstone Concept* addresses the need for adaptiveness from an institutional perspective.[15] It discusses scientific, technological, and social advancements in terms of human interactions, saying that such advancements should be "combined with appropriate doctrine and integrated effectively into the organization and training of Army forces."[16] The importance of ensuring integration and training in applying this concept cannot be overstated. The document also states:

> The Army must pursue emerging technologies to maintain its strengths, address weakness, exploit opportunities, and develop countermeasures to future threat capabilities and maintain its technological advantage over future threats.[17]

The Army will be able to maintain any technological advantage only by complementing advances in technology with concurrent and corresponding leader development that will ensure adaptiveness. To prevent catastrophic battlefield failures similar to the Air France disaster, the Army must consider how to use mission command systems in a way that does not increase complexity to unmanageable levels. In its drive to help commanders understand their OEs, the Army has built complex systems that *increase* the overall complexity of operations—and, hence, the uncertainty. The Army's mission command systems are robust, yet fragile.

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Brazilian Navy Commander Giucemar Tabosa Cardoso shows a satellite picture with the location of the wreckage of the Air France's Airbus A330-203.

## Notes

1. Army Doctrine Reference Publication (ADRP) 3-0, *Unified Land Operations* (Washington, DC: U.S. Government Printing Office [GPO], 16 May 2012), 4-1.

2. ADRP 6-0, *Mission Command* (Washington, DC: GPO, 17 May 2012).

3. Ibid.

4. Bureau d'Enquêtes et d'Analyses (BEA) pour la sécurité de l'aviation civile, translated from French by BEA, "Final Report on the accident on 1st June 2009 to the Airbus A330-203 registered F-GZCP operated by Air France flight AF 447 Rio De Janeiro-Paris" (Paris, France: BEA, Ministère de l'Écologie, du Développement durable, des Transports et du Logement, 2012), http://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf.

5. Andrew Zolli, "Want to Build Resilience? Kill the Complexity," *Harvard Business Review* (2 December 2012), http://blogs.hbr.org/2012/09/want-to-build-resilience-kill-the-complexity/ .

6. J.M. Carlson and John Doyle, "Complexity and Robustness," *Proceedings of the National Academy of Sciences of the United States of America* 99 Suppl 1 (19 February 2002), http://www.pnas.org/content/99/suppl_1/2538.full.pdf.

7. For an interesting discussion on military decision making and information technology, see John W. Charlton, "Digitized Chaos: Is Our Military Decision Making Process Ready for the Information Age?" (School of Advanced Military Studies [SAMS] monograph, Washington, DC: GPO, 1997), http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA339521.

8. ADRP 3-0.

9. For more information about the evolution of Army information systems as a means to reduce uncertainty, see Richard S. Jeffress, "The Continuing Quest for Certainty: Decision Superiority and the Future Force" (SAMS monograph, Washington, DC: GPO, 2004).

10. The major subordinate networks integrated into Command Post of the Future are—Advanced Field Artillery Tactical Data System, Effects Management Tool, Distributive Common Ground Systems-Army, All Source Analysis System, Battle Command Support and Sustainment Systems, Blue Force Tracker, and Command and Control Personal Computer. See a detailed listing at the U.S. Army National Guard Mission Training Complex website, http://www-bctc.army.mil/cpof.htm.

11. Anukool Lakhina, "We Need to Prevent Data Insights from Dying in the Big Data Avalanche," blog post at *GigaOM.com*, 6 October 2012, http://gigaom.com/data/we-need-to-prevent-insights-from-dying-in-the-big-data-avalanche/.

12. For examples of proponents' functional claims for Army information systems, see the Program Executive Office Command Control Communications-Tactical website, http://peoc3t.army.mil/mc/tmc.php.

13. For more about Gen. McChrystal's approach to information sharing, see Stanley A. McChrystal, "The Power of Sharing," videorecording, 7 May 2014, at http://www.trendhunter.com/keynote/information-sharing-talk ; and "It Takes a Network: The New Front Line of Modern Warfare," *Foreign Policy.com*, 22 February 2011, at http://www.foreignpolicy.com/articles/2011/02/22/it_takes_a_network.

14. G. Scott Gorman, "Adapting to Chaos: American Soldiers in Siberia, 1918-1920" (SAMS monograph, Washington, DC: GPO, 1998), 43, http://www.dtic.mil/dtic/tr/fulltext/u2/a366245.pdf.

15. Training and Doctrine Command, Department of the Army, TRADOC Pamphlet 525-3-0, *The U.S. Army Capstone Concept* (Washington, DC: GPO, 19 December, 2012).

16. Ibid.

17. Ibid.