Afloat Forward Staging Base (Interim) USS *Ponce* conducts operational demonstration of Office of Naval Research–sponsored Laser Weapon System while deployed to Arabian Gulf, November 15, 2014 (U.S. Navy/John F. Williams)

Breaking Through with Your Breakthrough

How Science-Based Communication Can Accelerate Innovation and Technological Advantage

By Dave Nystrom and Joseph Wojtecki, Jr., with Mat Winter

Communicating naval science and technology . . . is about our responsibility to convey truth and reality for informed decisionmaking. Lessons learned detailed here are as much about good leadership as they are skills for defense innovators.

—Rear Admiral Mat Winter, USN, Chief of Naval Research

Naval technology today can trace its origins to Office of Naval Research (ONR)–sponsored research, but in order for breakthroughs to reach the fleet, ONR has a responsibility to communicate warfighting value and foster informed support for implementation. This article shares some insights from decades of innovation and offers seven communication practices that can help innovators and leaders in military science and technology, not only in the Navy but also in the other Services.

As we scan the defense landscape, we see that threats are proliferating, adversaries are closing the gap, and the pace of innovation, once set by the Department of Defense (DOD), is exposing the consequences of our bureaucracy's declining ability to keep up. While innovation of all types is needed, the kind that enables us to win wars is technology-based. The Department of the Navy has a solid record of leveraging technology for decisive capability advantage, but often it is a stressful journey, sometimes calling for extraordinary intervention. We also contend with that most inelastic of naval cultural traits, tradition, which sometimes requires heroic effort and personal sacrifice from innovators to overcome.

Consider the case of Lieutenant William Sims. In 1900, Sims introduced continuous-aim firing for naval guns using gears and telescopic sights to compensate for a ship's roll, increasing accuracy by 3,000 percent. Nevertheless, his reports were systematically ignored or rejected by the Navy's Bureau of Ordnance—citing the technology as "unnecessarily disruptive to the social order of a ship." Exasperated, Sims wrote to President Theodore Roosevelt, who in 1902 intervened to circumvent Navy bureaucracy and appointed Sims as Inspector of Target Practice, where he commissioned and tested new gunnery to instill continuous-aim technology. He persevered, retired at the rank of admiral, and was credited as the "man who taught us how to shoot."[1]

Some may recognize this case study and be struck by the parallels facing modern defense innovators. From a communication perspective, Sims assumed too much: that facts speak for themselves, that he was an effective messenger, and that data-laden technical reports would counter intractable perception-based resistance. Sims underestimated the stress his innovation placed on the status quo and how that stress impacted gaining informed support.

Today, we do not lack smart people, talent, or good ideas. The problem remains at the point of implementation; this is the point where, after the initial exuberance of discovery and early support, the reality of overcoming resistance from "late adopters and laggards,"[2] combined with scaling the bulkheads of bureaucracy, sets in. Science-based communication, however, can help defense innovators break through with options well short of letters to the President.

Stress Impacts Communication

Innovation is the adoption of a new invention, practice, or idea.[3] Therefore, increasing the success rate requires deeper understanding of how to gain informed support. This seems straightforward, but the complexities of communicating innovation, and the changes invoked, are often oversimplified. Recall moments when you were involved in a crisis, had to deliver bad news, or had to persuade others on some controversial point. The message, messenger, and method all take on crucial significance in such circumstances. Effective communication in stressful situations draws upon an understanding of science-based principles that apply to the diffusion of innovation.

One point of reference for high stress that Americans vividly remember is September 11, 2001. Enormous uncertainty prevailed as the day unfolded. Horrific images are still etched in our minds. We were fearful, angry, and grieving. Shortly after the second World Trade Center tower fell, New York mayor Rudy Giuliani held a news conference to speak to the Nation. The first question he received was anticipated: "How many are dead?" His response was powerful: "Ultimately, the number is more than we can bear." He continued to express compassion, conviction, and optimism throughout the aftermath.

Giuliani's effectiveness might have been different had he responded only with casualty statistics or succumbed to the emotion of the moment. But in fact, his comments had been developed 5 years earlier during routine crisis preparedness planning, following a proven risk communication model. Giuliani developed this plan with support from the Center for Risk Communication, a research organization addressing how people process information differently in high-stress situations. While 9/11 is the extreme, the principles apply equally to everyday work- and home-life circumstances. In naval innovation, risk communication leads us to think beyond the factual merits of new technologies to consider stakeholders' concerns, needs, and perceptions.

Naval scientific research is the responsibility of ONR. It is the incubator for Navy technology innovation, and its mission is to ensure technological warfighting advantage for the Navy and Marine Corps. ONR's job is to discover, develop, and deliver decisive capabilities—and, when necessary, challenge the status quo. This often requires top cover, as Lieutenant Sims discovered, and is why ONR is among the few agencies in the Navy established by Congress.[4] Investments made decades ago have yielded discoveries in material science, pulse power, and advanced electronics that have led to today's technologies such as electromagnetic railguns, laser cannons, and autonomous systems with true swarming capability.

In each of these examples, communication played an important role in gaining informed support for advancing

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these new technologies. We discuss each case to illustrate key communication principles (which are *italicized* in the text), six strategic communication factors, and these seven conventional wisdom traps:

- Just get the word out.
- You cannot over-communicate.
- Decide, announce, defend.
- Facts speak for themselves.
- Silence is golden.
- Perception equals reality.
- Experts make the best messengers.

For railgun, lasers, and autonomous swarm, the most common conventional wisdom trap avoided was "just get the word out." How often has a blast email resulted in successful change? Too often, information dissemination is confused with effective communication. After the "word is out," it is tempting to check off communication as completed. In fact, *all information must pass through complex filters before it registers* with meaning for a receiver. These filters transform (limit and distort) information, especially under stress, so what the receiver hears may bear little resemblance to what the sender intended. These filters include:

- ability to focus on the information
- trust and credibility of the source
- alignment of words with actions.

The proper metric for communication is not what we say, but what others hear and do in response. This underscores the dual role of communication in technology adoption: First, we must have effective strategies to inform critical decisions. And second, we must understand stakeholders' points of view to anticipate potential resistance and advise decisionmakers on options for gaining informed support.

Electromagnetic Railgun: Overcoming Resistance

Railgun is a revolutionary advancement in naval gun technology. Developmental success has enabled rapid progress toward land-based and at-sea demonstrations. Railguns provide affordable solutions to costly challenges. What began as an ONR-funded project is now a technology for America's future fleet. Railgun uses electricity instead of gunpowder to fire hypervelocity projectiles at speeds up to Mach 7, at ranges 10 times farther than current naval guns, and with greater accuracy. Railgun is safer to operate aboard ships and is effective against multiple threats.

Dylan Ottman, from Office of Naval Research (ONR) Tech Solutions program, explains technology behind Fast-Tint Protective Eyewear during ONR 2012 Science and Technology Partnership Conference, Arlington, Virginia (U.S. Navy/John F. Williams)

Like Lieutenant Sims with continuous-aim gun technology, railgun is disruptive to adversaries and in a different way to those internally vested in the status quo. Dr. Elizabeth D'Andrea, the ONR railgun program officer in 2007, understood the advocacy challenges for railgun, and it became apparent that most were based on misperceptions, uninformed opinions, or lack of awareness. "Railgun was not being taken seriously by naval leaders," stated D'Andrea. "The lab team was making breakthroughs almost every day, but they did not know how to translate 'tech-talk' into 'fleet-speak' that naval officers understand." Additionally, some pockets of deeper resistance saw railgun as a threat to the existing political/social order of naval gun and missile technology.

D'Andrea understood the stress of time constraints, limited resources, and competing priorities on leaders whose support was critical. With then–Chief of Naval Research (CNR) Rear Admiral William Landay, it was determined that direct engagement with stakeholders at a demonstration was the best course. Invited were key decisionmakers, including then–Chief of Naval Operations (CNO) Admiral Gary Roughead and others who could speak to the technological merits with higher credibility than could ONR alone. Landay and D'Andrea also knew they needed support beyond DON and invited the news media. The event was positioned as a "World Record" demonstration of a 10-megajoule shot—then the world's most powerful railgun.

With so much on the line, spokespersons were prepared to deliver comprehensive structured messaging telling the compelling story accurately. At Naval Surface Warfare Center (NSWC)–Dahlgren on January 31, 2008, Dr. D'Andrea, her chief engineer Charles Garnett, and Rear Admiral Landay achieved success with an event that became known as the railgun "shot heard round the world." "This was a turning point for railgun. It earned CNO as a champion who understood its warfighting value. Going forward, communication became a major part of my job as visibility increased. We focused on gaining key stakeholders' trust and were very honest about our successes, failures, and challenges. Consistent messaging, backed up by results, was the key," stated D'Andrea.

National media coverage helped foster interest outside DOD and captured the public's imagination. Clips of railgun tests earned millions of views on the ONR YouTube channel. Railguns found their way into video games, science classes, and even Hollywood (for example, a Navy ship armed with railguns saved the planet in the *Transformers* sequel). Support continues, and railgun is on track to become an official program of record.

The conventional wisdom traps avoided in this example were "you cannot over-communicate" and "decide, announce, defend." Communication opportunities must be established between parties for innovation diffusion to occur.[5] The goal for the railgun example was to communicate for effect. Where mass awareness is the objective in marketing, in this case, building relationships with decisionmakers was key to success.

People are bombarded every day with more information than they can process. Railgun needed to cut through distractions to become the signal in the noise. This meant concise, clear, brief, and accurate messaging on an interpersonal level for mitigating resistance, fostering trust, and building a support network (old-fashioned, face-to-face conversation).

Innovators must see themselves as change leaders and understand their responsibility for communicating. Dr. D'Andrea made the railgun program very transparent to Navy leadership. Unfortunately, *an often-observed pattern in organizational communication is the DAD (decide, announce, defend) model.* Typically, executives huddle behind closed doors to make an important decision. Especially when the decision has negative impact on the workforce, as the decision is announced, leaders find themselves immediately on the defensive, scrambling to explain their decision to now angry and distrustful personnel.

Trust is based in perception and is essential for informed support. Valuing people means more than just informing them; it means involving and engaging them. The credibility lost from DAD is far less about the decision itself than how it was reached. *People expect a voice in decisions that affect them.* When that voice is denied, resistance (sometimes outrage) is predictable.

No matter how compelling a new technology may be, innovators must consider its potential negative impacts (real and perceived). Good communication strategies account for stakeholders' needs, expectations, and potential resistance.

Laser Weapons System: Addressing Barriers

High-energy laser weapons represent game-changing technologies. ONR is a leader in fielding directed-energy technology, and laser systems complement existing naval weapons. Lasers enable the Navy to fight at the speed of light. In 2014, the first operational laser cannon was installed aboard the USS *Ponce* and deployed to the Persian Gulf. Testing proved that lasers could work in the harsh maritime environment. Providing new levels of precision and speed for naval warfighters, laser weapons also increase safety because, like railguns, they use electricity rather than explosive propellant or warheads, eliminating ammunition magazines. A laser weapons system (LaWS) is tunable, giving commanders the option to fire a warning flash before a lethal beam. Current power levels are effective against small boats, planes, and unmanned aerial vehicles. They also cost less to build, install, and fire—less than $1 per shot—compared to traditional weapons such as multimillion-dollar missiles.

So why has it taken so long to get lasers aboard ships? After all, laser development started in the 1980s under the Ronald Reagan administration's Strategic Defense Initiative, or "Star Wars." The technical hurdles are significant. Weapons-strength lasers require large amounts of energy, both for the beam and for the apparatus itself. Early lasers suffered from system weight, low efficiency, and materials deficiencies. Focusing and targeting the beam aboard a moving ship in a maritime environment are also difficult computing and engineering challenges. Given these issues, one can understand the skepticism.

Peter Morrison, ONR program officer for LaWS, and his team approached the problem using a combination of commercial lasers normally used for manufacturing. They modified components and designed the system to achieve the necessary performance for a warship. In 2013, they were ready to test-fire aboard the USS *Dewey* against a drone. Within seconds of firing, the drone burst into flame and crashed into the ocean. The test was successful, but few knew about it. What did this mean for the Navy, the program, and the future of directed energy? Morrison had historical data from the project, test results, and high-resolution video. Would these facts speak for themselves? "True innovation should expect skepticism," stated Morrison, "and skepticism plays an important role in science, but it means one must communicate meaningful facts to stakeholders. This can turn potential skeptics into educated advocates." To leave the narrative interpretation to those feeling threatened by its success could provoke greater resistance. Morrison briefed then-CNR Rear Admiral Matthew Klunder, who, understanding the importance, provided support for a communication strategy.

The first step was to assemble program information into a message map. Message-mapping is a process that collects, organizes, and structures data into key messages, supporting facts, and proof points. The next consideration was messenger selection. For different stakeholders, messenger credibility varies, as does the effectiveness of various communication methods. Among the technical community, Morrison and his team engaged their peers and fellow program officers. They provided classified briefings to flag officers and officials, while Rear Admiral Klunder briefed peers and top-level decisionmakers. Internal support evolved along with alignment of messaging, both critical for addressing public inquiry. And media were already digging.

As the USS *Dewey* returned to San Diego, a reporter published a photograph showing a large white dome on its fantail, postulating that it could be a laser system. Rather than letting the rumor mill run amuck, the CNR decided to meet with media and get ahead of the story. At traditional news conferences,

Table 1. LaWS Message Map

High energy laser weapons represent game-changing technologies		Laser systems complement existing naval weapons suites		The U.S. Navy is a leader in fielding directed-energy technologies	
Inherently low engagement costs	50 cents per shot Vs. $1 OOs K per missile Deep magazine Suitable for low-budget environment	Effective against a range of threats	Small boats UAVs Sub-sonic cruise missiles Aircraft	Rapidly innovate in response to emergent threats	Mature science (well past physics) Have the power Successfully tested onboard a ship
Multi-mission capabilities	Deter asymmetric threats Protect shipping Terminal defense Transportable	Deployable on a range of platforms	Shipboard Airborne Ground-based systems	Deliver advanced capabilities to forward deployed forces	Ready to put on naval ships Currently in integration efforts Testing continues
Speed-of-light engagement	Precision Fast engagement time Radically maneuvering targets Limited collateral damage	Enhances ship combat effectiveness	Changes in naval tactics New ship designs Enhance procurement plans for ship-based weapons	Will continue to be introduced as technology matures	Navy platforms USMC platforms 2016 test at sea

27-9-3 Statement: "High energy lasers weapons represent game-changing technologies. The U.S. Navy is a leader in fielding directed-energy technologies, and laser systems complement existing naval weapons suites."

the spokesperson stands at a podium. However, to put people more at ease, ONR's media relations lead, Peter Vietti, developed a conversation-based roundtable format with Klunder as chief spokesperson and with Morrison attending to provide details. Reporters were invited to participate either in person or by phone. The resulting news headlines made the Navy's laser cannon known around the world with remarkable accuracy and consistency of messages. Awareness soared, and support followed.

Following the announcement, then-CNO Admiral Jonathan Greenert ordered the laser "out to the Fleet for operational demonstration." The program accelerated to install an advanced prototype aboard the USS *Ponce*. Testing in the Persian Gulf allowed Sailors to see its value firsthand, gaining their informed support and credible advocacy. Reporting this success also signaled a new age for the U.S. Navy to potential adversaries.

Today, a new generation of 150-kilowatt lasers is being developed for the *Arleigh Burke*–class of destroyers. The fiscal year 2016 defense bill "directs the Secretary of the Navy to develop a plan for fielding electric weapon systems," meaning both lasers and railguns. Laser weapons and railgun are paradigm shifts for the Department of the Navy, changing the doctrine of naval warfare. While prototypes have shown great promise, neither is a satisfactory solution, and both require future ships to be designed from the keel up to support electric weapons. This requires the Navy to make an "all in" wager. Making the shift from traditional guns and missiles requires long-term vision, communication support, and leadership from both military and elected officials.

The conventional wisdom traps avoided in this example were that "facts speak for themselves" and that "silence is golden." Relying on facts alone to resolve misperceptions is unrealistic in high-concern circumstances. Behavior is predicated on perceptions, and misperceptions often lead to behaviors that seem irrational from the perspective of reality. The innovators' challenge is that they may be too close to their ideas to see how others might fail to grasp the importance.

Research shows that *stressed people lose on average 80 percent of their capacity to process information (hear, understand, and remember)*. To mitigate this loss and optimize the remaining 20 percent of capacity, *the communicator must pre-process the information to make it more digestible*. The message map is designed specifically to pre-process information.

People can process three messages at a time. Message maps, therefore, arrange data in three levels of three: three key messages, three supporting facts for each message, and three "proof points" for each fact. This "27-9-3" structure helps people determine what is important (key messages) and whether the information is believable (supporting facts and proof points) (see table 1).

There are no information voids; something always fills them (usually rumors). There is strong temptation to withhold information until all decisions are made and all questions have answers. The problem with this "silence" is that stakeholders' needs do not remain on hold while leadership deliberates. Silence breeds uncertainty and distrust. Silence is antithetical to pre-decisional dialogue that could satisfy *people's expectation of having a voice (control) in decisions that affect them*—a prerequisite for support. The alternative is providing interim updates through two-way channels, clarifying what is known and what is not, steps taken toward clarification, and when the uncertainty will end.

Innovators must know that *uncertainty is a heavy psychological burden* on those whom their innovation might impact. A steady flow of meaningful communication relieving the anxiety of uncertainty enhances trust and acceptance.

Swarmboats: Managing Perceptions

With autonomous swarm, unmanned Navy vessels can overwhelm an adversary. A first-of-its-kind technology

Dan Wise, from Naval Surface Warfare Center, Dahlgren Division, prepares to take readings following successful test of Office of Naval Research–funded Electromagnetic Railgun, in Virginia, June 21, 2012 (U.S. Navy/John F. Williams)

enables swarming capability, which gives our naval warfighters a decisive edge. Autonomous vehicles are used widely across the Service on, under, and above the ocean. The next logical step is to connect them in new and meaningful ways. Swarming of autonomous systems opens new thinking about autonomy: improved ability to operate forward, protection of high-value assets (for example, the USS *Cole*), and multiplied combat power and improved distributed lethality at decreased risk.

In 2014, ONR demonstrated autonomous swarming technology in unmanned surface vehicles (USVs) on the James River in Virginia. The swarmboats simulated a "high value unit" transit such as the Strait of Hormuz, where Iran regularly employs swarm tactics (not autonomous) using small speedboats. Thirteen USVs in the test constantly shared sensor data and route information using a software/hardware kit called CARACaS (Control Architecture for Robotic Agent Command and Sensing), derived from the National Aeronautics and Space Administration's Mars Rover program.

Shutting down the James River and the airspace above it does not go unnoticed. Likewise, boats without people aboard maneuvering around the test range raise obvious questions from onlookers. And the dominant characteristic of swarmboats—their ability to act autonomously—rekindles dire perceptions about science-fiction scenarios.

Despite their benefits, autonomous swarmboats faced significant technical and emotional hurdles regarding whether a robot should ever make a lethal decision. From engineers to leadership, the answer was a unanimous *no*. This was a priority message. Additionally, before Sailors were asked to relinquish control to autonomous boats, the benefits of swarm and the trustworthiness of the technology had to be made clear. Sailors from the Naval Expeditionary Combat Command (NECC) were an integral part of the test. These "real" Sailors oversaw the swarmboats as supervisors oversee subordinates, giving direction and evaluating performance.

As with railgun and LaWS, the first step was to develop a message map with Dr. Robert Brizzolara, the ONR program officer responsible for autonomous swarmboats. Brizzolara and his team focused on what the technology does, how it works, and why it is important. The demonstration required coordination with ONR, NECC, Fleet Forces Command, NSWC-Carderock, Fort Eustis, and the Coast Guard to work just as a real-world scenario. On a hot August day, after years of research, multiple autonomous USVs successfully demonstrated the new swarming capability—both in escorting vessels and engaging hostile craft.

Benchmarking the prior success of the LaWS communication strategy, external outreach was delayed until internal Navy briefings were accomplished and support was gauged. The technology

was well received, and Admiral Greenert put his full support behind announcing the breakthrough. Once more, Rear Admiral Klunder was the spokesperson, lending his credibility to the warfighter benefits and addressing potential negative perceptions about autonomous systems. Brizzolara focused on the technology, publishing articles about the CARACaS kit in defense journals.

National media recognized the importance of this breakthrough and accurately reported the story, positioning the capability as a new defense against another USS *Cole*–like incident and as a counter to Iranian small boat operations in the Persian Gulf. "The first USV swarm demo was a key milestone in autonomous control for USVs," stated Brizzolara. "We demonstrated autonomous operation of a team of USVs in a higher-fidelity environment than ever before. We are building on that success, adding to the capability and planning more complex demos to further develop the technology." The swarmboat program conducted additional demonstrations and testing in 2016 and is on track for operational unmanned surface vehicles.

This technology is also revolutionizing unmanned aerial vehicles (UAVs)—part of ONR's Low-Cost UAV Swarming Technology (LOCUST) program. LOCUST can launch dozens of swarming UAVs to autonomously overwhelm an adversary. A ship-based demonstration of 30 rapidly launched, autonomous, swarming UAVs is planned.

In this third example, the conventional wisdom traps avoided were that "perception equals reality" and that "experts make the best messengers." A more accurate statement regarding perception and reality is that "What is perceived as real is real in its consequence."[6] Obviously, gaps occur between reality and perception. But the significance of these gaps might be surprising. *Simply introducing facts into a debate rooted in misperception is unlikely to resolve differences.* Applying this thinking to the introduction of new technology, such as autonomous swarmboats, illustrates how words and actions can promote *trust*, communicate *benefit*, and share *control*:

Table 2. Science-Based Communication Factors

Railgun (Overcame Resistance)	1. Intensity of Resistance: Low, Medium, High 2. Depth of Resistance: Opinions, Beliefs, Values
LaWS (Addressed Barriers)	3. Barriers to Informed Support: (Lack of) Awareness, Knowledge, Understanding 4. Overcoming Barriers: Inform, Involve, Engage
Swarmboats (Managed Perceptions)	5. Perception Factors: Trust, Benefit, Control 6. Interactions Shaping Perception: Dissemination, Interactive, Interpersonal

- Is the source of information trusted? (appropriate messenger)
- What are the benefits to me and others? (safe and cost-effective)
- How do stakeholders exert control? (Sailors supervise the USVs)

People judge the messenger before they listen to the message. Expertise alone does not make a trusted messenger. The critical characteristics for effective messengers are trust and credibility. If the judgment on messenger trustworthiness is not favorable, the message is irrelevant. When people are asked what their criteria are for trusting someone, responses fall into three broad categories: competence and expertise, honesty and openness, and caring and empathy.

In low-stress situations, competence and expertise account for approximately 85 percent of trust (whom do I trust to perform routine maintenance on my car?). *In high-stress situations, 50 percent of trust is based upon caring and empathy* (whom do I trust to guide me in a financial or health crisis?). In other words, people do not care what you know until they know that you care. With autonomous swarmboats, for example, we did not circumvent the issue of human-in-the-loop control—it was addressed head-on, acknowledging concerns about lethal decisionmaking.

One of the most powerful signals of caring and empathy is active listening. Innovators should take time to listen to stakeholder concerns upfront, ensure understanding, actively address them, and provide periodic updates. Even though concerns may be unfounded in reality, they are real to those holding them—and therefore legitimate. Words or actions minimizing the importance of stakeholder concerns will set back trust significantly.

Stressed people attribute 75 percent of message content to nonverbal signals: attire, posture, grooming, vocal qualities, and behaviors. Nonverbal signals are processed quickly—usually within 30 seconds for a presenter before an audience. When stressed, the most negative interpretation of any nonverbal signal will apply (folded arms, dry mouth, and shifting eyes would signal defensive and unapproachable, nervous and lying, and dishonest and deceptive).

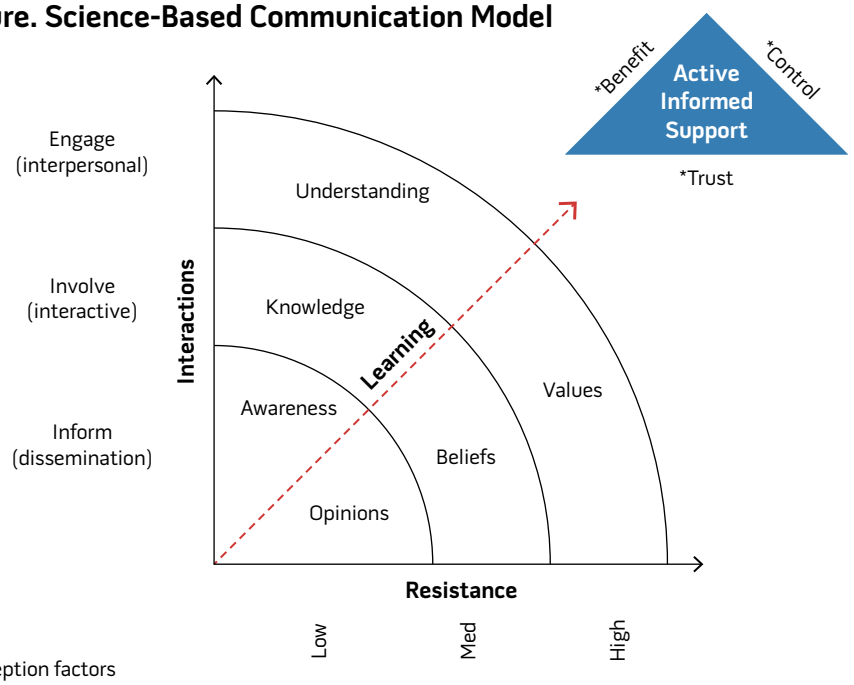
Trust is hard won and easily lost, so selection of credible messengers is critical. Credibility is relative; it varies by person, organization, and topic. Ranking the voices on a topic provides a "credibility ladder" that is a guide in selecting messengers. Since the military enjoys high confidence with the public, the CNR was a logical choice as spokesperson for autonomous swarmboats. The CNR, no matter who occupies the position, has the responsibility to lead ONR's command message.

Conclusions and Takeaways

The ingenuity of the men and women serving the Department of Defense is not in doubt—the challenge for innovators is developing informed support for implementation. Science-based communication principles change how we traditionally think about communication: from "get the word out" to careful planning for the concerns, needs, and perceptions of stakeholders. Communication informs strategic plans, and planning informs communication strategy.

We define communication as *the application of messaging, strategy, and tactics to achieve an effect*. Effectiveness depends on how well we resolve the

Figure. Science-Based Communication Model



*Perception factors

Chart 8: Learning is first a function of effective communication. "Active informed support" results from assessing depth of resistance (opinions, beliefs, values) against a range of communication methods (inform, involve, engage) to dispel or counter misperceptions. Perception factors are addressed through accurate messages and actions that foster trust, show benefit and share control. This promotes learning by expanding awareness, knowledge and understanding toward the goal of being the "signal in the noise."

factors that contribute to resistance, barriers, and misperceptions. Table 2 summarizes the factors discussed in each of the technology cases. Combining the "science-based communication factors" suggests a model uniquely applicable to the diffusion of technology innovation (see figure).

Leaders must set the conditions for innovation. Does the command climate support innovators (*trust*)? Are they recognized (*benefit*)? Are they empowered (*control*)? Military culture fosters the mindset that "what interests my boss fascinates me," so communicate that innovation is a priority, and put collaborative processes in place to engage people on a portfolio of mission-based initiatives. Change policies that inhibit innovation and agility (foster speed and decentralized authority). No matter how compelling a new idea or technology may be, a leader must empathetically understand the people it will impact and then act accordingly.

Based on lessons learned, we offer the following seven communication practices:

- Think "Down and In": Effective communication begins internally like the nervous system of an organization. Communicate goals to align your team, build relationships, and find support in your chain of command, then attract thought leaders as advocates and early adopters.
- Communicate for Effect: Develop communication strategy upfront by mapping stakeholder needs, concerns, and perceptions to foresee resistance and how to gain informed support.
- Anticipate, Prepare, Practice: Adopt high-stress communication principles to avoid conventional wisdom traps—common sources of failure in change initiatives.
- Signal in the Noise: Use 27-9-3 message maps to drive integrity and a consistent voice. Tell a compelling story with supporting imagery about what your innovation is, how it works, and why it is important.
- Find a Champion: Ally with a senior-level sponsor in a position commensurate with the change associated with your innovation.
- Know Your Audience: Identify credible voices for different stakeholders. Rank these against the relative credibility of opposing voices.
- Think "Up and Out": Communication with media can provide independent validation; this requires strong public affairs support.

Innovators are change leaders, which requires much more than a good idea to be successful. Science-based communication helps mitigate stress from innovation-induced change. Expanding communication beyond just "getting the word out" avoids conventional wisdom traps and focuses on dialogue with stakeholders and decisionmakers. Examples of communication at the Office of Naval Research provide a framework to think strategically: thinking "down and in" promotes internal alignment, and thinking "up and out" helps to proactively manage perceptions and expectations. "Breaking through with your breakthrough" is ultimately a function of your communication effectiveness to overcome resistance, lower barriers, and achieve informed support—an important competency for all leaders. JFQ

Notes

[1] Elting E. Morison, "A Case Study of Innovation," *Enineering and Science Monthly*, vol. 7 (1950), 5–11.

[2] Everett M. Rogers, *Diffusion of Innovation*, 5th ed. (New York: Free Press, 2003), 221, 267.

[3] Peter J. Denning and Robert Dunham, *The Innovator's Way: 8 Essential Practices of Successful Innovation* (Cambridge: MIT Press, 2010), 5–6.

[4] Public Law 588 of 1946, signed by President Harry S. Truman.

[5] Rogers.

[6] Vincent Covello et al., *Improving Risk Communication* (Washington, DC: National Academies Press, 1989), table 2.1, 35.