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Best Practices in Communicating about Science

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A Report of the CSIS Harold Brown Chair in Defense Policy Studies

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

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A Conference Summary of the
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The authors of this report are grateful to DuPont Protection Technologies for their support of the workshop and the publication of this summary. We also want to thank our speakers and panelists for donating their time to us. Without their expertise and input, we would not have been able to home in on the most pressing issues surrounding effective communication to support our national security needs. Finally, this event would not have happened without prompting from Dr. Arun Seraphin, a colleague and friend who has spent his career “talking the talk” and “walking the walk” of technology.

Executive Summary

In recent months, Department of Defense leaders have raised increasing concerns about the potential for the United States to lose its comparative advantage in multiple technology areas. To help address this trend, Secretary of Defense Chuck Hagel recently directed a "Defense Innovation Initiative" aimed at fostering the development of breakthrough technologies. Success in this effort will require a series of actions, but all rest on one critical factor: a shared understanding across the research and policy communities of the scientific potential and its importance to our national security going forward. Without that common view, scientists in both the public and private sector will be unable to sustain sufficient support to deliver meaningful advances.

Building that understanding in turn requires the ability to translate complex, highly technical, and often abstract information to a broad array of stakeholders with different cultures, knowledge, and language. This has always been a challenge, but the importance of meeting and overcoming it is particularly high at this point in our nation's history. To help address it, on November 7, 2014, the Center for Strategic and International Studies (CSIS) hosted a day-long workshop and conference focused on identifying best practices for communicating about science and technology (S&T). Conference attendees included representatives from across the (defense-focused) S&T enterprise, to include the Department of Defense, universities, the Congress, and the private sector. The conference portion of the event included a keynote address, two panel discussions, and a lunchtime address. The workshop portion included discussions in breakout groups in which participants developed recommendations aimed at supporting a greater shared understanding of defense S&T endeavors.

The day's discussions resulted in a series of recommendations aimed at improving both how and what information about S&T is presented, as well as at broadening the range of participants in the ongoing S&T conversation. More detail can be found in the main body of this report, but the recommendations can be summarized as follows:

- **All S&T producers** should employ the basic tenets of Communications 101: know your audience, identify the right messenger, and tailor the message.
- **S&T researchers** should increase opportunities for real-time feedback from policymakers by utilizing virtual prototyping and field-testing new technologies at early stages of development.
- **Nongovernmental S&T producers** should leverage professional societies to help communicate their work with Congress and other stakeholders.
- **Defense policymakers** should make an effort to increase their own understanding of science, technology, and engineering concepts in order to become better-informed consumers.
- In order to clarify S&T priorities, the **Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (AT&L)** should create a Defense Department-wide S&T weighting and scoring system to assess the

most pressing capability gaps and the programs best suited for addressing them, and direct the establishment of parallel systems within each military department. It should also make the results of those processes available to industry, academia, the Congress, and the public.

- To help better illustrate the utility of S&T investments, the **Office of the Under Secretary of Defense (AT&L) and the military departments' research and development officials** should develop case studies of historical returns on investment for key S&T initiatives. They should also ensure the collection of sufficient data about ongoing projects to support the continued production of such analyses going forward.

- **S&T producers** should acknowledge technological uncertainty, but cast it in the context of addressing what is needed to help reduce that uncertainty going forward.

- The **Office of the Under Secretary of Defense (AT&L)** should create a "suggestion box," supported by some small amount of funding, to directly solicit S&T ideas not subject to the traditional hierarchical staffing process.

- The **White House Office of Science and Technology Policy** should lead the development of additional cross-agency virtual exchanges (similar to the Defense Innovation Marketplace) for S&T consumers and producers.

While none of these recommendations will fundamentally alter the dynamics that make effective communication about S&T so difficult, their adoption may help to improve the quality of that communication going forward. As the Defense Department seeks greater technological innovation in earnest, any advances in this area will help to support that goal. Further, though not specifically addressed by attendees, the response to the CSIS event made clear that the S&T community is eager to engage in conversations about improving its communication. As a result, the authors offer three additional recommendations:

- The **Office of the Under Secretary of Defense (AT&L) and the S&T officials within each military department** should review available tools to help their scientists (both internal and external) successfully convey their work, and provide additional opportunities to share communication best practices on a routine basis.

- The **White House Office of Science and Technology Policy** should establish, through the National Science and Technology Council, an interagency working group to share best practices and develop new practices for the effective communication of complex scientific and technical topics to agency leadership, Congress, private-sector research performers, and the public.

- The **Office of the Assistant Secretary of Defense for Research and Engineering** should work with the American Academy for the Advancement of Science, the National Academies, and other organizations to establish fellowship opportunities for technical communications experts to work within the Pentagon, modeled on other successful fellowship and internship programs.

Conference Summary

On November 10, 2014, the Center for Strategic and International Studies (CSIS) hosted a one-day conference and workshop to explore the various perspectives on science and technology (S&T) communication. The event brought together key stakeholders from across the government, industry, and academia, with two intended outcomes. The first was to illuminate a range of perspectives on the best ways to obtain support for S&T activities, and in particular those conducted in support of the Department of Defense. The second was to develop recommendations for steps that can be taken to further enhance S&T communication. This document provides a summary of the day's discussion and the resulting recommendations.

Morning Keynote: Ben Riley, Principal Deputy, Deputy Assistant Secretary of Defense for Emerging Capability and Prototyping

After welcoming remarks by **Dr. Maren Leed, senior adviser at CSIS,** Mr. Riley opened the conference by describing recent efforts by his office to encourage the formation of a private consortium exploring new technologies for electromagnetic spectrum use. That experience, he noted, serves as an example of the challenge of communicating the value of a "shared test-bed" to different levels of leadership within and across various communities. The military services, he observed, value utility most highly, whereas the foremost concerns for many senior defense leaders are life-cycle cost and risk. Alternatively, the general public might only consider value to the taxpayer, whereas Congress considers the interests of all these communities to varying degrees. Navigating a path to communicate in ways that account for those disparate interests is a challenge, Mr. Riley noted, and one that is further complicated by the speed of innovation and the institutional resistance to change in the military.

Mr. Riley also emphasized that the content of messaging initiatives is as important as the intended audience. He cautioned against relying solely on past innovation cases such as ARPANET and GPS (Global Positioning System) to justify modern-day investment in future capabilities. Instead, he argued, cultivating support among policymakers and government agencies for investment in new capabilities requires a clear articulation of the potential applications of a new technology for current or future use. His experience has led him to discuss a technology in context by incorporating elements of the national security environment or the needs of the warfighter to generate a better understanding of its potential utility.

Mr. Riley observed that the need for better communication exists at every point in technological development, from basic research to the production of a tangible product. Communities of consumers and scientists will continue to talk past one another, he asserted, until concerted efforts are made to understand the implications of a technology at every phase of development. The importance of such sustained engagement between communities of producers and consumers of S&T is especially critical because "new technologies have to compete within an existing structure and with existing programs" for development funding as they mature. As such, Mr. Riley sees the maturity of the technology as a critical factor in how best to communicate its value.

Having discussed the challenges and importance of communicating about basic research, Mr. Riley briefly discussed how leveraging tangible, mature technological devices and capabilities can captivate nontechnical audiences. He returned to this point in the question-and-answer session, citing Frank Kendall, Under Secretary of Defense for Acquisition, Technology and Logistics, and Bob Work, Deputy Undersecretary of Defense, for their efforts to restructure performance metrics so as not to penalize prototyping that may not necessarily lead to programs. He stated, "if your report card is based on the number of things that went to operational use, to get a good grade, you're not going to take a lot of risks." Mr. Riley described the benefits of employing an iterative strategy involving a series of demonstrations as a key method to allow potential user audiences to better consider various technologies' usability and potential spillover effects while offering their own ideas as the technology matures.

Mr. Riley closed his remarks by noting two technology areas he believes offer great potential value: synthetic biology/chemistry and cyber. Mr. Riley urged that more needs to be done to understand the unique capabilities of cyber technologies. While noting that the Defense Department is a "physics-based organization," he also cited the opportunity for greater collaboration with the social sciences as human enhancement in the areas of endurance, strength, and intelligence become areas of growing interest.

Panel One: "Consumer" Perspectives

The conference then moved to panel discussions. The first, focused on capturing the perspectives of various stakeholders whose support for S&T initiatives is being sought, was moderated by **Mary Lacey, Deputy Assistant Secretary of the Navy for Research, Development, Test & Evaluation.** Ms. Lacey opened the discussion by observing that scientists can become mesmerized by the beauty of new technologies and often fail to understand why nontechnical audiences are not equally amazed or enthusiastic about the same innovations. In her experience, presenting the operational, rather than scientific, benefits of a particular technology is critical to successful communication. She then introduced the panelists and they offered their opening remarks.

The first panelist was **Dr. Kathleen Hicks, Senior Vice President at CSIS**. Drawing upon her long background in the Office of the Secretary of Defense, Dr. Hicks recounted the methods she had found most effective for communicating science and technology concepts. In her experience, defense policymakers respond best to framing new technology in terms of benefits to the decisionmaker or the warfighter, and specifically to gains in decision time, ability to gather information, potential for de-escalation, and survivability.

Dr. Hicks also touched upon the importance of understanding an audience and how it best receives and consumes information. Dr. Hicks noted that while she herself prefers written communications, many policymakers prefer visual modes such as charts or other graphics. Dr. Hicks closed her remarks by emphasizing the importance of having scientists genuinely evaluate and communicate the potential obstacles that could emerge between the proposal and actual delivery of a new technology. The more information a researcher can provide on political, budgetary, and technical challenges, she recommended, the more informed expectations will be, and the more

likely the project will receive continued support throughout the research and development process.

Dan Adams, Professional Staff Member on the Senate Armed Services Committee, served as the second panelist. He asserted that effective communications about S&T initiatives have two key ingredients. The first is that the technical aspects of the research are simplified into everyday English. He noted that while most of the people he works with are very bright, they typically do not have a technical background and are not familiar with technical jargon. Mr. Adams has observed that putting proposals in terms of capability enhancements has been an effective way of communicating with and persuading policymakers to support S&T efforts.

The second key element Mr. Adams looks for is a clear tie to a relevant national security issue. In order to justify having the Defense Department spend money on a project, especially in a time of fiscal constraints, he sees an imperative for a strong correlation to national security. If such a connection cannot be made, he said, the project will be much less likely to receive funding.

Mr. Adams's final comments pertained to the current status of the United States as a global technology innovator. Mr. Adams expressed concern that the United States no longer appears to be driving the technology conversation, and while he does acknowledge budgetary and other political issues have contributed to this development, he argued that the lack of effective S&T communication has been an important factor in the United States' contracted role in innovation on the global stage.

The final panelist was **Paul McLeary, Pentagon Correspondent for *Defense News***. His remarks focused on the difficulties science communicators face when attempting to relate elements of policy to new technology when the scientists and engineers fail to make these connections themselves. He lamented the fact that many researchers seem incapable of explaining what they do to nontechnical audiences, and often fail to recognize the source of audience incomprehension. Mr. McLeary then contrasted the current state of national security with that of a couple of years ago, noting that the new, more diffuse threats have made defining security issues and determining capability gaps much more challenging.

During the question-and-answer period, the panel fielded several questions on the roles of different communicators and what the best practices should be for individuals in different fields. One questioner asked what policymakers can do to give more focused signals to technologists and better indicate what advancements they require. Dr. Hicks responded that the onus should be on policymakers to be educated consumers so they can start asking the right questions. She continued that policymakers should also work to highlight which technology gaps are most in need of being filled, and prioritize their requests based upon the relative importance of the capability. Finally, Dr. Hicks emphasized that this is best done collaboratively, and that an open dialogue between scientists and policymakers is necessary to promote the best outcomes. When another audience member asked how well we are accomplishing these tasks currently, Dr. Hicks offered that she thinks we do well on a macro level, but that the results are more mixed at the level of investments *within* a given capability area. At that point, she said, policymakers often rely on the military

services, program managers, and the S&T community to position investments. She further observed that this process is not well suited for rapid turn capabilities, especially in the information technology area, that the Defense Department needs to leverage.

When asked if there was a particular way of presenting national security issues that would make it easier for decisionmakers to compare and make tradeoffs between funding defense technology and other budgetary components, Dr. Hicks replied that there is no decided algorithm for policymakers. Instead, she described the national security arena as one that relies heavily on professional judgment, with emphasis put on prioritization and with no sophisticated system. Mr. Adams added that proposals with simple language and brief, bottom-line statements were more likely to receive funding than those with long, drawn-out technical descriptions.

One audience member asked what the role of major contractors should be in communicating changes in science and technology priorities and facilitating the acquisition process. Dr. Hicks answered that contractors must have a prime role in this sphere, especially as the government attempts to downsize and reduce defense budgets. She offered that a significant portion of future innovation is expected to come from the private sector. As a result, she said, policymakers have to start thinking about where the country's industrial base needs to be in 10 years and create conditions where both large contractors and small innovators can be successful. Mr. McLeary added that he has observed a significant gap between what the Defense Department wants and what commercial industry, particularly smaller companies, can actually bring to them. Dr. Hicks suggested that this issue has not received enough attention.

In response to a question on what the Defense Department has done to promote basic research, Mr. Adams stated that he anticipates a lot of basic research being relegated to universities. If researchers expect to get funding from the government, they need to have a plan and preferably some product already in development that can be used as a "proof of concept." Scientists that come in with nothing more than an idea should expect to leave disappointed, he warned.

Panel Two: "Producer" Perspectives

The second panel, aimed at capturing the perspectives of various "producers" of S&T communications, was moderated by **Mary Miller, Deputy Assistant Secretary of the Army for Research and Technology**. Ms. Miller opened the discussion by describing outreach efforts as ongoing exercises in the translation of complex technical ideas into simple language and basic principles. She used an example of scientific exchange personnel in the Pentagon explaining the value of lighter-density armor in numeric and technical aspects, rather than clearly articulating the operational impacts—in this case the weight avoided—to the warfighter. She observed that while there is no shortage of enthusiasm and innovation within and outside of Pentagon labs, understanding the audiences and modifying messaging accordingly are continuing challenges that all technical communities must overcome.

She then introduced the panelists, beginning with **Jessica Tozer, Editor-in-Chief and content manager of the Department of Defense science and technology blog**

Armed with Science. Ms. Tozer began by describing her methodology for making complex ideas accessible to a wide range of technical and nontechnical communities. She noted that this involves communicating both to civilians with little to no baseline knowledge of Defense Department S&T efforts, as well as to military and scientific personnel who crave more nuanced and technical information. To effectively serve as a "techno-translator," Ms. Tozer said she tries to place S&T initiatives in a context that demonstrates how it impacts the audience directly. In her experience, scientists and technologists have a clear view of their role in creating products, yet struggle to make the implications clear to non-expert communities. She offered three basic topics for experts to incorporate when trying to communicate the utility of the technology they are developing: 1) intended end-uses; 2) the size of the technology relative to a product with which the audience is already familiar; and 3) compatibility with existing technologies. Because S&T ideas "have roots in things that people understand because they were once just imaginary," Ms. Tozer believes they can be made accessible to a wider audience once a context is clearly developed. She also noted the growing role of social media in communications, and argued that the Defense Department should continue to embrace social media and basic language to actively shape how nontechnical audiences interact with S&T knowledge.

The second panelist was **Rick Weiss, Director of Strategic Communications and Science & Technology Policy Adviser at the Defense Advanced Research Projects Agency (DARPA**). Mr. Weiss discussed the agency's role in creating "breakthrough technology" that can be applied to national security ends. While meeting national security needs is the primary responsibility of DARPA, he noted, the agency has a diverse portfolio that includes technologies with the potential for commercialization. That said, he acknowledged that DARPA faces the same two challenges that other scientific and technical communities encounter: articulating complex ideas and generating interest among diverse, nontechnical audiences.

Mr. Weiss then addressed what he sees as two major misconceptions about DARPA: that all projects are secret, and that it is a policy agency. He acknowledged the policy issues surrounding enhanced capabilities, to include privacy and autonomy in unmanned systems, and noted that science, technology, engineering, and mathematics (STEM) education will be central to debates about the future scope of technology. However, he continued, though these policy issues draw attention from largely nontechnical audiences, they are not under the purview of a projects agency such as DARPA.

Finally, Mr. Weiss described some of DARPA's public engagement initiatives, which range from an active social media presence to participation in approximately 25–40 media inquiries per week. DARPA directors also play an active role in doing outreach and speaking engagements at academic and other institutions. Mr. Weiss emphasized that S&T communications and outreach are fundamentally aimed at "getting new communities of researchers that might not have been together before." To that end, he offered the annual DARPA Robotics challenge, which invites participating groups to design a robot for use in a humanitarian assistance and disaster relief (HA/DR) scenario, as one such networking example.

The third panelist was **Tiffany Lohwater, Director of Meetings and Public Engagement for the American Association for the Advancement of Science**

(AAAS). Ms. Lohwater, who runs AAAS's many training efforts to enhance scientific communication, emphasized the importance of audience and accessible language. She described the main challenge as experts who are comfortable in their expertise being most comfortable talking to other experts. In her view, the tendency of experts to limit their interactions to like-minded, niche communities has implications for their understanding of what issues and technologies are most relevant to the general public.

Ms. Lohwater also cited technical jargon as another significant difficulty experts face when communicating with both technical and nontechnical audiences outside of their subject matter areas. To help overcome this, she said, scientists and technologists must be asked to "take a step back from content" and examine the wider context in which S&T decisionmaking takes place. She also emphasized that outreach should vary by medium as well as by audience. As an example, she noted that approaching staffers on Capitol Hill in person versus communicating with a wider audience using internet tools requires varying degrees of finesse from experts. Ms. Lohwater also cautioned against generic "data dumps" of technical information, arguing instead for a strategy that identifies basic principles tailored to the interests of specific audiences. Finally, she said that experts must become more adept at communicating from the perspective of what they perceive is important to their audiences and not necessarily what they believe to be the more important aspects of their work. One such strategy she highlighted is a "bottom-line up front" method that leads with a discussion of major findings first, followed by the more detailed information.

The fourth and final panelist was **Dr. Kevin T. Corby, Global Technology Director for DuPont Protection Technologies.** Dr. Corby noted that industry scientists and technologists face a similar set of communications obstacles to their counterparts in government. He saw the primary difference in the private sector's rare opportunities to directly interface with policymakers. Instead, he described, many industry innovators often work through intermediaries to provide their products to the government. The existence of a third party complicates communications, making it essential for S&T industry experts to streamline their messaging to reduce the risk that their work is misinterpreted or misrepresented. Beyond reaching government audiences, Dr. Corby noted that S&T experts in industry must be able to convince business leaders that their technologies are worth investing in. He described this as a particular challenge given the tendency of business leaders to prefer measurable or tangible outcomes, which is counter to the incremental nature of S&T progress. To address this reality, Dr. Corby believes researchers must communicate how progress in basic research meets the needs of company stockholders.

The question-and-answer period opened with a question about how to best manage the expectations of S&T stakeholders. The participant noted that excessively promoting a technology or capability could create disillusionment and result in funding cuts if the capability deviates from how it was advertised. Ms. Tozer acknowledged that "hype" is a facet of dealing with large audiences, especially when an issue is not fully understood. She stated that although experts cannot control how information is disseminated, they must strive to remain truthful to their ideas and concepts in their communications. Ms. Lohwater also validated the difficulty scientists face in trying to communicate the impacts of their research to diverse audiences. Specifically, scientists struggle to make connections to the needs and interests of

nontechnical audiences while acknowledging the benefits may not be realized immediately. In her view, scientists and technologists have a responsibility to be proactive in the early phases of project development to clarify the specific implications of their work to the greatest degree that they understand them.

Another audience member posed a question about whether there are differences in how best to communicate about social versus "hard" sciences. Ms. Lohwater noted that social scientists do not necessarily communicate more effectively, but are often necessary for understanding the implications of the hard sciences. She suggested that hard and soft science experts working collaboratively can create more compelling messages to their respective audiences. Ms. Miller built on these observations by discussing the difficulty in communicating human dimensions, such as cognitive and social skills, as metrics for individuals to organizations such as the Army that work as teams rather than as individuals. Dr. Corby added that social sciences are not characterized by clear cause-and-effect relationships, which can make communicating their outcomes more difficult than for the hard sciences. Mr. Weiss observed that the marriage of behavioral studies and big data is a growing area of interest, and predicted that as the methodologies driving behavioral studies become more scientific, their accuracy and predictability will likely raise uncomfortable issues.

A question was asked regarding the managing of instances where security concerns might suggest scientists should avoid communicating about the research and development of specific technologies and capabilities. Ms. Lohwater stated that in the modern world the discovery and spread of information is largely outside the control of those who would otherwise keep it hidden. She suggested that all S&T communities need to think proactively about various possible scenarios should information become public against their wishes and how to have public conversations about their projects regardless of whether they intend to keep them secret. Ms. Tozer added that the benefits of proactive communicating, especially through social media, will allow Defense Department S&T stakeholders to shape the direction and content of the conversation from the outset.

The final two questions focused on DARPA and Defense Department-funded S&T projects. The first inquiry was about how the organizations that conduct DARPA-funded work can best support the overall communications process. The second questioner noted the difficulty of identifying the totality of Defense Department S&T projects, and asked whether there might be a more efficient way to track developments. To the first question, Mr. Weiss noted that communications efforts between DARPA and its partner laboratories are not coordinated for more basic research, and that while DARPA likes to be informed about partners' public communications, there is no need to pre-clear them. For more advanced work, he said, DARPA prefers a more collaborative approach to help avoid misunderstandings and create greater clarity. On the second question, panelists agreed that virtual tools such as the Defense Technology and Information Center were incredibly difficult to navigate and don't really function as effective outreach and communications tools. They noted, however, that the Defense Innovation Marketplace functions as a more streamlined interface for these purposes.

Lunchtime Keynote: Harry Wingo, President and CEO of the D.C. Chamber of Commerce

Mr. Wingo, a former Navy SEAL and Google evangelist, delivered the lunchtime keynote address. He began by reflecting on the unique approach the United States takes to fostering technological advancement. He asserted that it is the culture of the United States, and its devotion to freedom, that allows innovation to thrive and bolster not only our national defense, but our nation's prosperity as a whole.

The difficulty often lies in communicating these benefits to the public and investors. Mr. Wingo recounted the story of Edgar Sengier, the man who ultimately provided the American government with much of the uranium it needed for the Manhattan Project. When Mr. Sengier first offered to provide the American government with uranium he was written off, but when the government needed uranium two years later to begin their nuclear research program, his stockpiles were quickly utilized. Mr. Wingo offered this account as a testament to the challenges technology communicators face, particularly when informing government bodies, but also as confirmation of the benefits of revolutionary technologies and evidence of their historical relevance. Mr. Wingo emphasized the necessity of using these past technology successes to persuade nontechnical audiences to invest in future innovation efforts.

Mr. Wingo then offered some insights he gained from his time at Google on how to best communicate the value of technology innovation. He noted the importance of having a message for both users and shareholders, as these two audiences often have very different opinions of what "matters" for a new technology. He argued that winning users' support requires scientists to convince potential users that a new technology meets one of their current needs, or that it can perform a task better than what they are already using.

Mr. Wingo concluded remarks by noting that there is a "new literacy" of coding, and that the possibility of incorporating technology demonstrations into the learning process for future generations holds real promise. Mr. Wingo posited that adding cyber simulations and exercises to the curriculum at military academies would expose young service members to the applications and benefits of technology at an earlier age, and create a test bed for experimentation and development of new technologies and innovations.

After his keynote address, Mr. Wingo fielded questions from the audience. When responding to a question about how the D.C. Chamber of Congress is trying to help other businesses communicate S&T more effectively, Mr. Wingo was very optimistic. He highlighted the Chamber's partnership with the Small Business Administration (SBA), and noted that the SBA is conducting consultations out of the Chamber's offices. He also stated that he is trying to connect the people in his office with military and S&T backgrounds with other businesses in the District that would benefit from their expertise. He noted, however, that this initiative is still new, and that additional federal resources are required to communicate with local state and government actors and help facilitate the dialogue between policymakers and Chamber experts. This is a program he hopes to expand further going forward.

When asked how the Chamber is using modern technologies to promote civil engagement, Mr. Wingo recounted his own experiences with social media, such as Twitter, that he has used to engage the public and promote various initiatives. He emphasized the necessity of communicating with all audiences, particularly those internationally that are looking to invest in D.C., and acknowledged that technology itself is essential for communicating with these audiences and facilitating the dialogue on science and technology.

Working Groups

Following the lunchtime address, remaining attendees broke into smaller working groups to continue the discussion and develop recommendations to enhance effective S&T communications. The groups reconvened in an afternoon plenary session to share the results of these conversations.

Group One

The discussion in the first group revolved around three main issues: what to communicate, how to prioritize what to communicate, and how the government and researchers can improve their communication processes.

The group came up with a number of recommendations for exactly what needs to be communicated in order for discourse to be meaningful and successful. The first question that researchers need to ask themselves is about the problem they are solving. In order to generate support for a project, champions need to effectively communicate what problem society has, how people are currently addressing the problem, and how the new technology will address the problem better. The next question scientists and communicators must address is: what's in it for the funder/people? Knowing exactly what audience is being addressed is imperative for successfully communicating the need. The government employs both young college graduates and folks near retirement. These two audiences require different communication methods in order to be effective. As one participant put it, communicators need different messengers for different audiences, with the same message. The exact content of these messages was identified as needing to be different as well, but generally, realistic estimates about what is needed now in order to receive "X" later were recommended. One participant noted that scientists need to be wary of overselling their ideas in order to avoid hype and risk a loss of credibility in the event of failure.

Recommendations on how to prioritize issues focused around the idea of metrics. As Dr. Hicks mentioned in the first panel, much of the decisionmaking on security issues relies on judgment. The participants recommended that a more logical and mathematical approach be used to determine the needs of the public and the government, in order to better facilitate communication to researchers on what innovations are needed most urgently. The power to drop projects when needs have already been fulfilled or when they show minimal results was also discussed, as dead-end projects were interpreted as bogging down the research process as a whole.

The group also discussed what government and businesses can do in particular to better facilitate science communication. The idea of having an in-house science writer or communicator, rather than a contractor, was posed as a potential solution to the communication problem. A more comprehensive solution was also proposed, wherein S&T communication was to be made a core competency of an organization, requiring a leadership commitment and a flattening of the communication process. The participants concluded that the most important feature an innovation needs is a champion. A credible champion with a science and business background, and a significant stake in the success of a product, was seen as being the most important and most effective communication tool for a new technology.

The group also touched upon issues such as avoiding the use of technical jargon, doing test runs with family and friends before communicating to policymakers, and organizing more forums where industry, scientists, and politicians can convene to discuss their own needs and concerns directly. These practices would allow for real-time feedback on the communications process and were believed to enhance the process as a whole.

Group Two

Participants raised several common themes throughout this discussion. There was a consensus that government and private organizations recognize the same set of challenges but fail to coordinate responses. Building on this observation, it was agreed that the way the technology industry views government differs from the government's view of the technology industry's role in meeting its needs. The technology industry is moving farther away from viewing the government as a viable source of funding, which is emblematic of the communication issues it faces.

The differences between S&T and R&D were also discussed, with most participants feeling that R&D identifies a need and meets it, while S&T is more exploratory and can involve maintaining expertise. The treatment of S&T communications as a monolith was viewed as problematic because users and developers perform different communications functions through various stages of technological development.

Participants felt that the most pressing challenge is empowering innovators to effectively get their products and ideas out on the market. Related to this issue is the challenge the technical workforce faces in translating work on abstract ideas and tying it to practical problems. From an acquisitions standpoint, this will be difficult for two primary reasons: (1) the acquisitions system today is not equipped for the pace of current innovation; and (2) there are virtually no points of reevaluation once the acquisition process starts because the technical community solicits outside solutions for every contingency before working the problem themselves.

The conversation turned to a discussion about the hubs of innovation within government agencies and the private sector and the need for greater opportunities to interface in areas beyond acquisitions and S&T program planning. It was suggested that virtual ideas and requirements exchange models such as the Defense Innovation Marketplace and the Small Business Innovation Research (SBIR) program could be enlarged and replicated. These advances were praised yet tempered with a broad recognition that organizational challenges persist. It was stated that virtual exchanges

favor “need-based innovation” over “opportunity-based innovation,” the latter being a more effective model according to participants. They argued that need-based innovation creates fixed stovepipes and isolated innovation “bubbles,” while opportunity-based innovation exposes S&T practitioners to new models and ideas.

The Defense Innovation Marketplace represents need-based innovation to the degree that the model depends on outside innovators submitting proposals in response to established priorities. Two challenges emerge: 1) proposals are then evaluated based on their ability to meet an existing requirement; 2) this model presumes that private innovators are able and willing to identify specific government requirements. Given the limited contact between government and private innovation spheres, participants expressed skepticism over requirements and acquisitions-oriented virtual exchanges and their ability to produce needed innovation. It was suggested that a “big data” approach to centralizing requirements and proposals to match producers and consumers would apply resources more effectively.

The point was made that people who focus on developing requirements often forget about the mission or actual problem confronting the warfighter. This was seen as problematic because of the belief that innovation is best fostered by solving a specific problem. Some participants felt that when communicating these issues crafting wholly different messages was unnecessary if you could make the message about the mission and include nuanced information specific to the community being engaged. It was then raised that S&T communicators rarely take into account the multiple constituencies who may be interested in the technology being developed. Organizations tend only to have one component of the problem for which they are responsible. This leads to disjointed and unclear messaging due to the absence of a common top-level understanding among the various S&T stakeholders. It was suggested that in order to apply a whole-of-government, top-level approach to uniform communications, government agencies needed to identify subject-matter experts (SMEs) to meet on a more regular basis. This needs to be done because agencies share responsibility in framing their needs and must do so effectively in order for developers to clearly understand that need and communicate their proposed solutions accordingly. This strategy has the added benefit of improving confidence in government, according to participants.

A question was raised about whether the onus is on the consumers or the producers to communicate better. Participants agreed that this would depend upon whether the technology is addressing a known need, or whether it is a possibility for an emergent opportunity. Furthermore, the onus might be on the producers of technology to understand the mission and to better articulate what they can do within the context of the mission. A point was then raised about communicating the costs and benefits of investing in specific technologies over time. For example, it was proposed that if an adversary could figure out a way to counter a capability within a month after it was first fielded, would that technology still have been worth investing in? Participants expressed mixed views about how to approach such a scenario, but agreed that the basic research behind any endeavor was still valuable. Building on the discussion of future capabilities, there was some tension as part of the group felt that researchers needed to conceive of methodologies to frame their concepts in a manner consistent with how they envision the technology being used. Others believed that doing so prior

to development and testing could lead to unrealistic expectations from nontechnical communities about what the technology can provide.

Participants largely felt that the way in which uncertainty in technological development is captured has leadership implications, especially when risks are not clearly understood. Building on Mr. Riley's comments from the morning keynote, participants felt that as long as risks, opportunities, and benefits are clearly stated from the outset, risk-takers and innovators should not be penalized for their work. The point was made that the incentive structure in the private sector is different, as they must consider both technical risk and economic risk.

Group Three

The discussion in group three focused on identifying what needs to be communicated, what methods have been most effective or could potentially be most effective for communication, and the different mediums of communication that are most effective at informing different audiences.

Understanding the entire development chain, from basic research to translation, was touted as one of the most important factors for facilitating effective S&T communication. Policymakers need to be familiar with who is doing research and who the major players are in the S&T field. The players and translators themselves need to be able to realistically outline the potential risks, capabilities, and outcomes of an experiment as early as possible, and be able to translate these potential outcomes into "so what" verbiage instead of just "what." The group suggested using historic examples of successes that have reliable data to do 20- to 30-year return on investment (ROI) analyses to correlate investments and returns. They also emphasized that future projects need to have data taken from the very beginning of the experiment and periodically throughout the research process. Collecting data will also help answer any inquiries that arise during the course of the research. There was a long discussion about how the S&T community should address the issue of communicating ranges of potential outcomes, and whether being technically accurate about uncertainty undermines potential support for a project. Some in the group argued that providing policymakers with definitive data points and numbers, rather than ranges, is a more effective way of communicating progress, but acknowledged that certainty should not be oversold. Instead, using periodically recorded data to inform about the methods and techniques needed to gain more certainty when addressing an inquiry was championed as being more persuasive than just saying "we're not sure."

The group also proposed a number of communication methods they believed would be most effective at informing policymakers. One group member provided an anecdote about how much easier communicating with the press and government bodies was when executives were able to work with engineers throughout a research process. The participant also noted how successful live demonstrations for executives, reporters, and politicians were for gaining market support. Interacting with members of Congress directly, or leveraging professional societies to communicate with Congress, were also posed as solutions to the problem of communicating S&T to policymakers.

Mediums for communication were also discussed in detail. The group recognized that different people absorb information in different ways, and suggested that publications be tailored to meet the different communication needs of its audiences. Using diverse methods of communication, including written, video, and dynamic content, as well as products targeted to either "left-brained" or "right-brained" audiences, were seen as much more effective than trying to find a one-size-fits-all solution. Demonstrations for nontechnical audiences as well as technical audiences were promoted as beneficial. Some participants suggested that war games and simulations where participants can experience firsthand how new technologies could be used to solve problems can also have a significant impact. Additionally, the team noted that fundamental differences between the science and technology fields themselves should be taken into account when formulating communication methods, and suggested that separate methods of communication might be needed for the individual STEM (science, technology, engineering, math) fields.

The group discussion also touched upon the issue of facilitating cross-organization communication in order to synthesize ideas and ensure duplicate studies are not being conducted. Incentive structures for scientists were also discussed. Members observed how little incentive scientists perceive to communicate more effectively, as the vast majority of their feedback and professional legitimacy comes from the community of their (technically savvy) peers. Finally, the group noted the necessity of integrating S&T into day-to-day thinking for executives and policymakers as being essential for true comprehension, questioning, and communication of science and technology.

Recommendations

In general, the working groups' recommendations fell into three broad categories. The first were specific ways in which *how* various parts of the broader S&T enterprise can improve understanding. The second were steps that can be taken to enhance *what* is communicated. The third area of recommendations focused on ways in which *who* is included in S&T activities can be broadened.

How to Improve Shared Understanding

- **All S&T producers** should employ the basic tenets of Communications 101: Know your audience, identify the right messenger, and tailor the message. Focus on the "so what," and employ a range of methods (verbal, written, visual, etc.) to maximize the likelihood of effectively transmitting information.

- **S&T researchers** should increase opportunities for real-time feedback from defense policymakers by utilizing virtual prototyping and field-testing new technologies at early stages of development.

- **Nongovernmental S&T producers** should leverage professional societies to help communicate their work with Congress and other stakeholders.

- **Defense policymakers** should make an effort to increase their own understanding of basic science concepts in order to become better-informed consumers.

Ways to Enhance What Is Communicated

- In order to clarify S&T priorities, the **Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (AT&L)** should create a Defense Department-wide S&T weighting and scoring system to assess the most pressing capability gaps and the programs best suited for addressing them, and direct the establishment of parallel systems within each military department.

- To help better illustrate the utility of S&T investments, the **Office of the Under Secretary of Defense (AT&L) and the military departments' research and development officials** should develop case studies of historical returns on investment for key S&T initiatives. They should also ensure the collection of sufficient data about ongoing projects to support the continued production of such analyses going forward.

- **S&T producers** should acknowledge uncertainty, but cast it in the context of addressing what is needed to help reduce that uncertainty going forward.

Broadening *Who* Participates

- The **Office of the Under Secretary of Defense (AT&L)** should create a "suggestion box," supported by some small amount of funding, to directly solicit S&T ideas not subject to the traditional hierarchical staffing process.

- The **White House Office of Science and Technology Policy** should lead the development of additional cross-agency virtual exchanges (similar to the Defense Innovation Marketplace) for S&T consumers and producers.

Summary

This conference illustrated the strong interest in, and imperative for, bridging the divide between the scientists who develop and produce new technologies and the policymakers whose support enables that research. A number of key tensions were highlighted that contribute to the complexity of that superficially straightforward task. One of the most fundamental is policymakers' desire for clarity about future uses, for predictable progress, and for efficiency; while necessary and reflective of their responsibilities, each of these concerns can lead to a narrowing of scientific inquiry. Should the S&T community cleave too closely to areas in which returns on investment are more certain, utility is predetermined, and technical evolution is low risk, opportunities for breakthroughs may become increasingly constrained. Evidence of this tension was apparent throughout the day's discussion, where participants called both for greater clarification of scientific priorities but also cautioned against proscribing technology areas of interest too narrowly so as to preclude innovation. (To some degree, this conversation echoes a decades-old defense debate about whether it is better for policymakers to specify needs in terms of *how* things will be

done or in more generic *capabilities* necessary to support military ends.) How the national security enterprise as a whole strikes a balance between scientific exploration and technological production will play a significant role in maintaining the degree of technological excellence our leaders have stated must not be forfeited in the future.

Forging a successful path requires building and maintaining trust, coupled with a shared understanding. This conference aimed to explore ways in which that objective might be furthered. While the challenges are many, opportunities clearly exist. Participants had the opportunity to share perspectives from a variety of vantage points, and to develop specific recommendations for actions that can be taken to enhance the conversation. The discussion clearly illustrated that "talking technology" is not likely to ever be easy, and that sustained effort by all parties is required. The steps identified as part of this conference will assist in the effort, but all participants also agreed that the conversation about S&T communication must continue.

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