

KATIE A. WILSON, JEFF ANDERSON, BIANCA ESPINOSA, JONATHAN L. BROSNER, KRISTIN VAN ABEL, ERIC LANDREE

# Development and Adoption of Emerging Technologies at the U.S. Department of Homeland Security

## Ideal Future States and Pathways to Achieve Them

**T**he size, structure, and breadth of the U.S. Department of Homeland Security (DHS) and its mission areas present numerous challenges for the successful integration of new technologies into the department. Each component focuses on specific mission areas and objectives, and the degree of overlap between components and within components themselves can vary considerably. Despite this organizational complexity, DHS benefits from the development and adoption of new innovations and technologies that can serve many mission areas. To develop them, DHS headquarters and component leaders must continue their institutional efforts to innovate efficiently so that new technologies support many missions, increase integration across components to reduce the siloing of operations, and foster a culture that promotes technology development and adoption.<sup>1</sup> Most recently, DHS sought to improve department integration by hosting the Strategic Industry Conversation IX: Innovation, Research, and Development Show-



An FFRDC operated by RAND  
under contract with DHS

case. This event increased transparency about the department's key innovation, research, and development (IRD) areas of interest and helped DHS prepare for its forthcoming inaugural fiscal year (FY) 2024–FY 2030 IRD strategic plan.

To identify other opportunities and pathways for facilitating DHS development and adoption of emerging technologies, we used a modified version of a future state group brainstorming activity commonly referred to as a *Cover Story Vision* or the *Cover Story Game* (hereafter, simply *Cover Story*)<sup>2</sup> to develop conceptual notions of ideal states for which DHS might aim by 2030. This Cover Story activity challenges each participant to think outside the box and use their unconstrained imagination to develop a future state so incredible that their organization is featured on the cover of a popular publication. Typically, the brainstorming activity consists of identifying not only the cover story but also the supporting headlines, sidebars, quotes, and images

that describe big successes and convey details about how the organization was able to achieve these successes. One of the strengths of using this technique is that participants assume that the future state has already happened, forcing them to set aside any disbelief and planting the seeds for future states that might not have otherwise been thought of as achievable.

We modified the Cover Story activity slightly to fit the goals of this effort. Instead of integrating headlines under one cover story, we developed three plausible future states to illustrate for DHS more than one way of thinking about the future, as shown in Figure 1.

Although many future states exist, we highlighted three areas that might warrant prioritization by DHS leadership. We concentrated the three plausible future states on issues related to (1) collaboration and coordination of technology IRD across the department, (2) the transfer of technologies that can support more than one mission and component, and (3) the successful transfer and adoption of technologies by components for immediate and long-term use. For each future state, we discuss why DHS leadership should be motivated to achieve this end state, options for making progress toward these outcomes, challenges that might be encountered, and possible ways to overcome identified obstacles. These three cover stories imagine a future state in which these challenges have been mitigated through purposeful actions.

The future state cover stories in this paper should be read independently of one another, though there might be overlap in concepts, challenges, and mitigations among them, which we discuss later in the paper.

### Abbreviations

AFWERX	Air Force Research Labs Work Project
AI	artificial intelligence
DAF	Department of the Air Force
DHS	U.S. Department of Homeland Security
DOT	U.S. Department of Transportation
FY	fiscal year
GAO	U.S. Government Accountability Office
IRD	innovation, research, and development
IT	information technology
NOAA	National Oceanic and Atmospheric Administration
R&D	research and development
S&T	Science and Technology Directorate

FIGURE 1  
Cover Stories



## **A Unified Plan for Technology Adoption**

The first ideal future state, in which DHS has a unified plan for technology adoption, is outlined in the box.

### **Why Should DHS Be Motivated to Achieve This End State?**

#### **Improved Internal and External Coordination**

By establishing a unified plan for adoption of the three documents described in the box, DHS will be situated to effectively coordinate its strategic goals both internally (across components and offices) and externally (with

industry; academia; Congress; and other federal, state, local, territorial, and international partners).

#### **Achievement of Strategic Goals and Missions**

A unified plan for strategic planning and adoption has been demonstrated to strengthen organizations and improve effectiveness.<sup>3</sup> Together, the three documents will help DHS achieve its strategic goals and overarching missions, providing awareness, coordination of roles and responsibilities, and coordination of funding. An IRD strategic plan, which would take into account current and future research and development (R&D) efforts in DHS, will help identify a series of crosscutting themes that align with individual strategic goals and objectives. The Imple-

## Cover Story: Unified Plan Supports Coordinated Technology Adoption Across the Department

Today DHS announced the release of the next iteration of a unified, three-part plan to drive new research initiatives within the department and accelerate the adoption of new technological capabilities. The DHS IRD Strategic Plan for Fiscal Years 2031–2037, together with the accompanying implementation plan and road map, will provide a blueprint for technological innovation. Together, the strategic plan, implementation plan, and road map will codify the alignment between IRD activities occurring within the components and DHS missions, objectives, and the desired future state of DHS operations and capabilities.

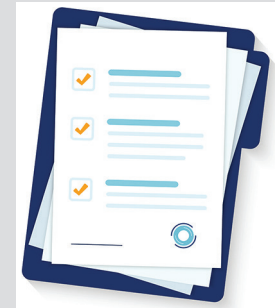
The unified plan and accompanying documents have already been used by DHS to support new research initiatives within the department, coordinate with other civil and military departments and agencies on activities of common interest, increase the pace of new capabilities reaching the operational components, and accelerate the development of new commercial capabilities to support DHS missions and operations.

The strategic plan, implementation plan, and road map allow DHS to assess and communicate the magnitude, direction, and timing of IRD-related outputs and to measure their contributions to specific DHS missions, objectives, and desired outcomes. These efforts will enable DHS to connect IRD investments with specific desired outcomes and help inform IRD investment and allocation decisions across DHS.

The updated unified plan is the result of seven years of effort. Following the inaugural DHS IRD Strategic Plan Workshop in 2023, the department released its first DHS IRD Strategic Plan for Fiscal Years 2024–2030. It also established standing working groups organized around crosscutting technologies or R&D themes that transcend components. These groups are led by representatives from the operational and support components, and its members include representatives from the components that are driving IRD activities and DHS stakeholders who benefit from DHS achieving stated goals and outcomes.

Over the past seven years, DHS has also constructed a comprehensive, up-to-date inventory of all IRD activities across the DHS operational and support components and mapped them to specific DHS missions and objectives. The inventory includes expected outputs from IRD activities and intended customers or end users and describes the specific ways in which they will contribute to DHS missions, objectives, and desired outcomes.

The unified plan ensures that DHS IRD activities and their contributions to desired missions, objectives, and outcomes are now measurable and coordinated across DHS and with partner U.S. government departments and agencies and the commercial sector. The plan is allowing DHS to make purposeful and informed contributions to its missions and objectives through informed and coordinated investments in IRD across DHS.



mentation Plan will help with the coordination of roles and responsibilities for achieving the missions and goals contained in the IRD strategic plan and identify metrics for measuring progress toward a desired end state. Finally, the IRD road map will help provide a high-level overview of key goals and milestones that DHS wants to achieve over the course of the IRD strategic plan.

## How Can DHS Achieve This End State?

DHS can achieve this end state by communicating a unified vision and set of goals, establishing a culture of employee engagement and input, establishing clear component roles and responsibilities, and creating measurable metrics and performance indicators.

## Communicate a Unified Vision and Goals

Research has focused primarily on four aspects of organizational vision: development, articulation, communication, and implementation.<sup>4</sup> Furthermore, organizations with strong innovation track records have been demonstrated to have established a strong, internal innovation ambition and vision that captures the core adjacent and transformational areas of innovation in the organization.<sup>5</sup> Beginning with a clear and concise unified mission statement and establishing strong alignment between the mission statement and strategic goals,<sup>6</sup> organizations can help align the operations of diverse components with the overall strategic vision of the organization.<sup>7</sup>

## Establish a Culture of Employee Engagement and Input

Having a published, comprehensive, departmentwide IRD strategic plan, implementation plan, and road map would allow employees involved with IRD to understand how their efforts contribute to the broader DHS vision and goals. This benefit would include a shared understanding of what constitutes IRD across DHS operational and support components. *Employee engagement* has been defined as the cognitive, emotional, and behavioral components that are associated with individual role performance,<sup>8</sup> and *organizational engagement* has been defined as the “harnessing of organizational members’ selves to their work roles.”<sup>9</sup> Studies have demonstrated that an employee feels engaged when they are connected to their organization’s goals, vision, and purpose.<sup>10</sup> When engagement is built into how an organization operates, it can become a “fundamental tenet.”<sup>11</sup> By inspiring members of the organization to be part of the vision and direction the organization wants

to take, members will feel a sense of ownership over the desired outcomes.<sup>12</sup>

## Establish Clear Component Roles and Responsibilities

Adoption of an IRD strategic plan, implementation plan, and road map involves awareness of the goals and desired end states DHS wishes to achieve and a clear layout of internal roles and responsibilities. By identifying which individual components and offices are contributing to meeting the goals laid out in a strategic plan, DHS can help organize responsibilities and create accountability throughout the organization. Individual components will be able to keep track of their R&D responsibilities and understand how their efforts are contributing to the overall DHS IRD mission.

An example of how the adoption of these plans can be achieved is provided by the U.S. Department of Agriculture’s *Strategic Plan Fiscal Years 2022–2026*. The U.S. Department of Agriculture illustrates how crosscutting themes directly relate to the strategic goals and objectives with a matrix.<sup>13</sup> The mapping of strategic goals and objectives to component responsibilities creates structure around the strategic vision and helps integrate the operations of diverse components in the organization. In another example, the U.S. Environmental Protection Agency identifies crosscutting research priorities for six highly integrated and transdisciplinary national research programs in its strategic research action plans.<sup>14</sup> These plans are intended to guide the development of research products that address the needs of internal and external partners and stakeholders.

## Create Measurable Metrics and Performance Indicators

Performance indicators help guide organizations and their members and allow them to monitor progress toward strategic objectives and goals. They can be measured through a combination of quantitative and qualitative metrics and can be associated with one or more strategic objectives. An example of a federal organization that establishes clear metrics and performance indicators is the U.S. Department of Transportation (DOT), with its *Strategic Plan FY 2022–2026*. In this plan, DOT identified several strategic goals and corresponding strategic objectives.<sup>15</sup> Under each strategic goal, DOT identified key performance indicators, which include desired dates and metrics relative to the strategic goal and the lead agencies that are primarily responsible for helping DOT reach those goals. In doing so, DOT encourages monitoring progress toward the strategic objectives and longer-term goals of the organization.

## What Challenges Could DHS Face in Pursuing This End State and How Can They Be Mitigated?

### Complex Organizational Structure

Given the size and complexity of DHS's organizational structure, there are a number of unique hurdles that DHS will need to overcome to achieve a unified plan for adoption. DHS is one of the largest U.S. federal agencies.<sup>16</sup> Studies have shown that larger organizations have higher internal inertia, which slows organizational change.<sup>17</sup> To implement change or adopt large-scale agile prac-

tices, culture often needs to be changed throughout the organization.<sup>18</sup>

DHS also has diverse components and offices with distinct missions. Each component has some autonomy with regard to setting its own IRD priorities. This heterogeneity creates varying and sometimes disparate missions across the organization.

### Unified Plan Rigidity

Plans contain road maps that lay out the steps an organization intends to take to achieve desired goals and end states. In doing so, a unified plan creates essential structure but also potential rigidity. This rigidity might prevent organizations from taking advantage of new opportunities or effectively managing unexpected obstacles if the event was not originally accounted for within the framework of the unified plan. Implementing a successful unified plan involves ongoing communication and coordination with different areas of the organization to better understand potential evolving landscapes and opportunities that might be worth seizing. By building flexibility into a unified plan, an organization can better ensure road map execution while taking advantage of opportunities that further support its vision.<sup>19</sup>

### Different Processes, Standards, and Tools for Information-Sharing

Having different processes, standards, and tools for information-sharing across the department also creates disjointed coordination among components. Constantly changing technologies and constrained funding have been

noted as contributors to information-sharing problems DHS faces.<sup>20</sup>

### Mitigation Actions

There are a number of things DHS can do to mitigate these challenges. One involves leadership encouraging and facilitating communication between components and offices. Given the diversity of components and missions across the department, having standardized processes to help identify gaps, coordinate roles, and measure progress toward desired outcomes will help the DHS Science and Technology Directorate (S&T) and other components executing IRD harmonize IRD activities aligned to various DHS missions and help crosswalk priorities across components. In addition, a governance mechanism is needed for managing processes across the components, with established roles and responsibilities and levers to hold participants accountable for their contributions.

Standardizing information technology (IT) systems across the department can also help with streamlining communication and data-sharing. Though it might not be feasible to establish a central IT system for the entire department, having standards in place regarding how different IT systems communicate through secure channels, both internally among components and externally with partners, can help facilitate communication processes. This standardization is especially important for consolidating all IRD activities in the department, which would enable components to better share, report, and analyze information in and across components.

## One Technology, Many Missions: Emerging Technologies Are Making a Difference—in Many Ways—Across DHS Components

The second ideal future state, in which DHS uses emerging technologies across many missions, is outlined in the box.

### Why Should DHS Be Motivated to Achieve This End State?

#### Collaborative Innovation, Research, and Development Benefits

The One Technology, Many Missions initiative can help DHS components optimize IRD strategies, which is important given resource constraints and the department's obligation to meet the diverse mission goals and objectives on multiple fronts. Information-sharing through the initiative will increase cross-component awareness of each other's responsibilities in supporting the DHS strategic plan, which is issued every four years.<sup>21</sup> The initiative will also improve coordination between components in developing strategies to meet shared DHS objectives.

#### More-Efficient Use of Technologies

In addition, the One Technology, Many Missions initiative supports efficient use of emerging technologies. Information-sharing helps components learn how a technology can be used to support their strategies and DHS's missions as a whole. A technology required for one component's strategies might be used in whole or in part by another component to meet the same objective, or a com-

## Cover Story: From Innovation to Application—DHS Finds Multiple, Diverse Uses for Emerging Technologies

DHS's new One Technology, Many Missions initiative is providing an accelerated approach to identifying and implementing widespread technology applications across DHS, allowing components to more readily take advantage of IRD breakthroughs. The initiative responds to a longtime challenge facing DHS: Given the diversity of missions within DHS, how can emerging technologies be developed, customized, and integrated to meet the broad variety of components' missions, challenges, staffing requirements, and fiscal resources?



The initiative is built on a foundation of ongoing cross-component networking and coordination, with component representatives meeting regularly to share ideas about needed capabilities, explore the capabilities of emerging technologies, and identify potential applications for new technologies within DHS. The initiative also relies on partnerships with leading external research organizations and developers in government, academia, and industry—known as the Triple Helix—who help components learn about new capabilities and discover uses relevant to DHS.

The benefits of One Technology, Many Missions can already be seen in the way artificial intelligence (AI) has been successfully integrated across component operations, where it is providing capabilities in video surveillance, facial recognition, contraband detection, anomaly detection, fraud prevention, and disaster prediction, among others. Components are also using AI to help first responders with emergency medical services and health care decisionmaking and guidance, and 911 call centers with prioritization and recommendations.<sup>a</sup>

AI has also been used successfully in the battle against opioid trafficking, where it has been applied to overcome the cartels' digital encryption tactics, identify network members, and detect shipment patterns and anomalies from complex big data.<sup>b</sup>

But this is not an overnight success story. Years of planning on cross-component coordination played a significant role in understanding the capabilities of AI and identifying ways to use this technology within DHS. The initiative also benefited from such efforts as the AI pilot program solicitation, the AI infrastructure operation, and the online child exploitation and abuse investigation.<sup>c</sup> The One Technology, Many Missions initiative itself was inspired by a bold research agenda first proposed in 2023 by Melanie Cummings, director of DHS S&T's Technology Centers Division,<sup>d</sup> and took advantage of the publication of the inaugural DHS-wide IRD Strategic Plan.

<sup>a</sup> National Urban Security Technology Laboratory, *SAVER TechNote: Artificial Intelligence/Machine Learning Technology Uses for First Responders*.

<sup>b</sup> DHS S&T, *Advanced Opioid Trafficking Analytics to Aid Investigations*.

<sup>c</sup> Kusnezov and Hysen, "Artificial Intelligence Task Force (AITF) 60 Day Update."

<sup>d</sup> Cummings, "Research Agenda Prepares for the Future of Science and Technology."

ponent might identify other applications of the technology to meet its strategic objectives.<sup>22</sup>

### Support for Joint Development of Technology

The One Technology, Many Missions initiative also supports components' ability to jointly develop an aspect of technology, or an entire technology, for a given applica-

tion. There are several advantages to this approach. For instance, DHS as a whole might benefit from economies of scale because the joint design and development of a given technology might use fewer capital and labor resources than would be needed if each component were to develop its own application.



Greater application utility could also be derived from the diverse perspectives involved in collaborative design—the equivalent of a private-sector, market-based approach to determine the user needs for product development.<sup>23</sup> Additionally, the involvement of multiple components in the definition, research, and development phases of the application can encourage additional inter-component communication to ensure DHS-wide technology deployment, avoid rejection of ideas not originating within the organization, and bridge otherwise-siloed efforts that can hamper innovation.<sup>24</sup>

Whether further benefits are realized depends on whether a technology is developed internally or externally.<sup>25</sup> In some cases, developing technologies in house can lead to longer development timelines that entail greater risk not only because of a lack of required expertise.<sup>26</sup> The transparency and scrutiny from public overseers associated with government development also can lead to more risk-averse decisionmaking, which might result in solutions and technologies that are less innovative and that might not achieve the desired mission or goals.<sup>27</sup>

Acquisition of existing commercial technologies can reduce timelines, especially in cases of as-is acquisition of an off-the-shelf product.<sup>28</sup> When such products are deployed for more-immediate use applications, the acquisition pathway can minimize the risk associated with both the R&D timeline and performance uncertainty. Should further modification of the technology be required to support short-term mission objectives, it can be done internally or through external partnerships via contracting or collaborating with external R&D efforts. Similarly, long-term development can also be achieved through contracted or collaborative external relationships. These acquisition

approaches are often used by the U.S. government. For example, the Operational Technology Division of the Federal Bureau of Investigation continually maintains close ties with the private sector to bring new technologies in house and find new collaborators for future needs.<sup>29</sup>

Collaborative partnerships can be crucial for public-sector innovation.<sup>30</sup> Innovation literature suggests that external partnerships allow R&D value to be maximized through resource optimization,<sup>31</sup> thus decreasing associated costs and risks and the knowledge and innovation rate.<sup>32</sup> One explanation for this effect is that innovation in the public sector is no longer seen as a linear process but rather as a spiral process.<sup>33</sup> Driven by entrepreneurial universities and research institutions and by government collaboration with academia and the private sector, the Triple Helix is seen as an effective means of meeting public innovation needs because industry and government expertise is coupled with the increasing commercially exploitable and applied knowledge from universities and research institutions.<sup>34</sup> DHS S&T is already following some of these practices through partnership programs designed to increase the involvement of academia and industry in solving the country's security challenges.<sup>35</sup>

## How Can DHS Achieve This End State?

### Establish and Nurture Internal and External Partnerships Based on Information-Sharing

At a basic level, the One Technology, Many Missions initiative requires strong internal and external collaboration and partnerships. Key to the success of these collaborative efforts is regular information-sharing with existing and potential new partners.<sup>36</sup> Proactive outreach to potential

partners can familiarize new entrants with government processes and clarify roles and responsibilities,<sup>37</sup> avoiding conflict at later stages and improving efficiency.<sup>38</sup> It is also important for leaders to share information about roles and responsibilities to both reaffirm existing relationships and establish new ones.

### Support Champions of Innovation

Organizational flexibility will be critical to support information-sharing and discussion about possible technology applications and their uses across multiple components. This flexibility can be facilitated through champions in component leadership roles who are willing to take risks, have the skills and capacity to coordinate the collaborations, and can keep those involved aligned with the objectives.<sup>39</sup> These champions must also be able to create teams that represent a diversity of perspectives, skills, and experiences and enable people on these collaborative teams to seek out innovation.<sup>40</sup>

### Build a Road Map for Innovation

A road map can help define innovation priorities and timelines for integrating technologies. The road map should map IRD activities across the DHS components to specific DHS missions and objectives. Program strategies, processes, and solutions should be geared toward mission-specific and objective-specific horizons and toward both short-term and long-term horizons.

This road map should be updated regularly to ensure that it continues to meet component and DHS needs. Although the department and S&T might only periodically publish strategic plans with short horizons, internal docu-

mentation should encompass a longer horizon and be regularly reviewed for its alignment with strategic goals.<sup>41</sup>

## What Challenges Could DHS Face in Pursuing This End State and How Can These Be Mitigated?

### Bureaucracy and Red Tape

Although forming external and internal partnerships might aid innovation, the bureaucracy and tight organizational reporting structure of public-sector institutions can be barriers to establishing and maintaining these collaborations.<sup>42</sup> For example, red tape can slow communication and delay decisionmaking and funding.<sup>43</sup> Red tape can also be a barrier to entry for external organizations; those who already understand expected roles and how the system operates could benefit from a legacy bias, while potential new partners without prior experience could be deterred from collaborating.<sup>44</sup>

For internal partnerships, disconnected communication could be a barrier to effective collaboration. One such communication breakdown could result from the classification level of the technological innovations. For example, information gleaned from technological innovations from a classified project might not be able to inform the development of the same technology on an unclassified project, even though the same component is involved in each application.<sup>45</sup> A breakdown in communication that results in component siloing could also occur if there is insufficient capacity or mechanisms in the components to track and disseminate the innovative technological solutions.<sup>46</sup>

## Insufficient Flexibility in Seeking and Applying Technological Solutions

Integrating technologies across component objectives through collaborative partnerships is not a one-size-fits-all solution, and treating it as such through organizational rigidity can result in falling into an innovation trap. In commercial product development, the strategy and process for product creation depend on the market conditions (stable, evolving, or dynamic) that influence the innovation rate for the industry.<sup>47</sup> The innovation rate tends to be lower in mature industries that have stable markets, while the rate will be higher for newer industries with evolving or dynamic markets.

## Mitigation Actions

The negative effects of rigid government structures and bureaucratic red tape can be minimized by increasing organizational flexibility by having DHS S&T and components share information with existing and potential new partners, as described in the previous section, including clarification of roles and responsibilities. This is particularly relevant when many components are engaged in the development of one technology across several applications. In that situation, a power dynamic could be created in which the application or technology becomes too aligned with the perceived needs of one organization. This dynamic could occur if the organization is in a leadership role, if it is significantly larger than other collaborators, or if there is a bias related to organizational autonomy, internal politics, or the perception of leadership's actions.<sup>48</sup>

Leaders with strong collaboration skills can also play a key role in addressing this challenge. Leaders should continually monitor team output and adjust the innovation

program to realign with the departmental missions and objectives.<sup>49</sup>

To address challenges related to insufficient flexibility, DHS program strategies, processes, and solutions need to be capable of evolving: Modifications can be required for short-term and long-term issues. From the private-sector perspective, this means that the innovation portfolio should be divided according to incremental and disruptive IRD activities for the short- and long-term requirements.

One implication of this portfolio structure, according to a GAO report on innovation best practices,<sup>50</sup> is that each innovation type should take a different path for the organization that conducts the activity and provides the funding. Short-term activities (within five years) are conducted and funded by business units, while long-term activities are corporately sponsored. A similar horizon-based approach is used in the Navy, in which funding is invested into short- and long-term projects and protected for potentially disruptive innovations.<sup>51</sup> This type of funding approach would address an existing constraint for DHS, which is that components do not have access to shared funding and investment opportunities, making joint R&D efforts challenging to execute. Furthermore, the portfolio should be reviewed at least once a year to realign activities over a horizon of up to 15 years.

From the DHS perspective, the portfolio implications are that different types of partnerships might be sought in the external collaborations and that the components' roles in the partnerships could change according to the components' horizon and objective requirements. Both of these requirements should be reviewed at least once per year to make appropriate redirections in roles and to bring on necessary new activities and terminate unnecessary ones.<sup>52</sup>

## An Organizational Culture That Supports Technology Transfer

The third ideal future state, in which DHS culture supports technology transfer, is outlined in the box.

### Why Should DHS Be Motivated to Achieve This End State?

#### A Supportive Environment for Technology Transfer

Organizational culture is an important driver for how technology is designed, individuals' attitudes toward technology adoption, and the extent to which new technologies are accepted in the workplace.<sup>53</sup> Organizations that are hierarchical, risk-averse, and bureaucratically rigid present cultural barriers to innovation, which can, in turn, create a resistance to new technologies at the individual level and lead to implementation challenges experienced across the broader organization.<sup>54</sup> Consequences of implementation failures can include lost innovation, continued use of outdated legacy technologies, and an enduring Valley of

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Organizations that are hierarchical, risk-averse, and bureaucratically rigid present cultural barriers to innovation.

Death, in which technological innovation does not transfer successfully from research to operations. In contrast, to ensure that these outcomes are not experienced in DHS, the organization must establish a culture that welcomes new technologies across components and mission areas.

#### A Culture Aligned with Technology Adoption

An environment that promotes both democratic decisionmaking and accountability across all levels of staff promotes positive technology adoption behaviors.<sup>55</sup> Furthermore, employees are more likely to develop a sense of ownership for those decisions and are therefore more likely to champion new technologies when they are initially introduced in the workplace.

### How Can DHS Reach This End State?

DHS has previously demonstrated efforts to align organizational culture with its highest priorities, such as actions to increase employee engagement and morale.<sup>56</sup> A cultural alignment that prioritizes technology transfer and adoption would also require action across all levels of the organization. DHS can achieve this end state by taking actions to promote a collaborative and cocreative technology IRD process; ensure staff access to training and education; and foster a risk-tolerant environment that supports learning, mistakes, and failure.

#### Involve Developers and Users in Collaboration and Cocreation

Collaboration and cocreation (i.e., joint efforts between developers and users) are essential for ensuring that technology design and choice are driven by the intended

## Cover Story: Cultural Change at DHS Facilitates Adoption of New Technologies

The organizational culture of DHS is playing a key role in promoting the successful adoption of new technologies across the agency. Employees are experiencing a culture that fosters continuous learning, and training programs are supporting upskilling and reskilling across the agency. As a result, employees now feel more confident and competent in using new technologies in their workflows.

The organizational shift began in 2023, when component leaders initiated several efforts to support a more-flexible learning environment. These included steps to break down silos in and across organizations, embrace a risk-tolerant environment, and involve employees in decisions regarding technology acquisition.

Efforts to break down silos across DHS have resulted in cross-component collaboration, with employees sharing knowledge, expertise, and best practices for adopting technologies regardless of their mission areas. Leaders across DHS are supporting a more risk-tolerant environment when new technologies are introduced. As a result, employees are supported through the inevitable learning curves and failures that occur as part of the adoption process. Finally, a strong effort has been made to involve employees in the decisionmaking about technology adoptions. Through this involvement, employees across all levels of DHS are building trust and developing a sense of ownership over the chosen new technologies.

An important outcome of these efforts is that new technologies are being championed in DHS, making the adoption of new technologies smoother and more successful than ever before. This cultural shift has led the metaphorical Valley of Death (a phrase used to describe the difficulty of transferring technological innovations from the research environment to operators' hands) to shrink.

Overall, the cumulative efforts of breaking down silos, embracing a risk-tolerant environment, and involving employees in key decisions for technology acquisition are facilitating DHS's successful adoption of technologies that are both component-agnostic and component-specific.



users' preferences, behaviors, and needs.<sup>57</sup> These interactions are also essential for empowering employees as decisionmakers—and not just customers—of technologies. By participating in the organization's technology decisionmaking process, employees' interest in the outcome of technology decisions increases.

### Diffuse Technology Adoption Through Communication, Education, and Risk-Tolerant Environment

Ensuring the widespread diffusion of new technologies to all intended users requires efforts that move beyond initial collaboration and cocreation actions. Collaborative relationships must transcend DHS over the longer term

across leadership levels, across components, and within components themselves. Communication to potential users must provide transparent information, such as data-driven insights, integration obstacles, and productivity expectations.<sup>58</sup> This transparent information is important for building trust in the organization and increasing willingness to integrate technologies into workflows.

Furthermore, DHS leadership must invest in its employees by developing and providing education and training that sufficiently prepares the workforce for use of the new technology. This investment must be coupled with a nurturing and tolerant environment, such that DHS accepts disruption to workflows while technologies are adopted, forgives mistakes resulting from early use of

the new technology, and recognizes that some technology adoptions do fail.

### U.S. Government Agencies Provide Examples of How Culture Can Support Technology Adoption

Several U.S. government agencies are already demonstrating efforts to develop and maintain a strong culture for technology adoption. For example, the Air Force Research Labs Air Force Work Project (AFWERX) has a primary goal of fostering a culture of innovation within the service. AFWERX works to bridge the Valley of Death by “driv[ing] faster technology transition to operational capability” for technologies that are developed across academia, industry, and government.<sup>59</sup>

Through this program, AFWERX is also achieving a strong technology adoption culture by enabling airmen and guardians to participate in the organization’s decisionmaking process. For example, airmen and guardians are invited to submit their own ideas through the AFWERX Spark

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Tank program, and a subset of these ideas are then funded to put new and needed technologies in operators’ hands. In 2023, 138 submissions from across the U.S. Air Force and U.S. Space Force were considered in the AFWERX Spark Tank.<sup>60</sup> This program presented a new opportunity for service members who are not normally at the cutting edge of research, development, test, and evaluation to engage in the innovation of new technologies for the Department of the Air Force (DAF). Ultimately, six submissions were selected as finalists to be pitched in front of DAF leadership, including the Secretary of the Air Force, chief of space operations, and Chief of Staff of the Air Force.<sup>61</sup> A subset of these pitches were then funded, which enabled airmen and guardians to engage in the decisionmaking process from the start, and, in turn, promoted a stronger culture for that technology’s adoption once transferred into operations.

In another U.S. government agency example, the National Oceanic and Atmospheric Administration (NOAA) seeks to quickly transfer NOAA technologies from research to the user in a cost-effective manner with a technology transfer program. Much like AFWERX, NOAA encourages its staff and outside stakeholders to submit technology concepts for consideration in the technology transfer program. As previously mentioned, intragovernmental participation in the technology decisionmaking process promotes a strong organizational culture around technology transition.

## What Challenges Could DHS Face in Pursuing This End State and How Can These Be Mitigated?

### Organizational Complexity

DHS is likely to face challenges in technology transfer and adoption because of multiple factors. First, DHS is the most diverse organization in the federal government, with 22 government agencies in a single federal organization. Additionally, DHS is the largest federal law enforcement agency in the United States, with approximately 80,000 officers across nine agencies.<sup>62</sup> The diversity of the missions and the size of the department present challenges for the broad adoption of new technologies across multiple components or mission areas. These challenges are amplified by a lack of shared component funding, siloed component programs, and congressional directions focused on singular components.

### Rule-Focused Culture

The public sector also faces challenges that are broadly applicable to DHS. Public sector organizations are often described as having a culture “focused on internal stability and adherence to rules and procedures, rather than one of flexibility, innovation and openness.”<sup>63</sup> Such a cultural environment can have several implications for technology transition, including small budgets that preclude the acquisition of new technologies, cultural resistance to new technologies, technology skill gaps, and compliance and security concerns.<sup>64</sup>

### Budget Limitations

Similarly, if DHS has a limited or uncertain budget for the acquisition of new technologies, their adoption would be affected. Uncertainty in budget planning can arise because of the restrictions that are required when operating under continuing resolutions, which can have consequences for DHS’s ability to develop new programs, hire new staff, and issue new contract awards for discretionary programs.<sup>65</sup> Even if a budget sufficiently supports the acquisition of a technology, DHS could face cultural resistance and choose to maintain the status quo or decide not to upgrade legacy systems. For example, GAO found that DHS operated outdated legacy IT systems that supported financial, biometric identity, and grant-management systems.<sup>66</sup>

### Skill Gap and Ethical Concerns

Even if funding and willing attitudes embrace a new technology, DHS could face a skill gap among operators who are not prepared to use and maintain new systems. Skill gap challenges could be further compounded by operators’ ethical concerns about using new technologies; if people are uncomfortable with adopting a new technology, they are unlikely to integrate the technology willingly. Examples of technologies that could raise ethical concerns are DHS’s implementation of facial recognition technology and experimentation with generative AI.<sup>67</sup> Both new technologies could have underlying ethical concerns, such as privacy, civil rights, and civil liberties issues.

### Mitigation Actions

There are steps that DHS can take to mitigate culture-related challenges for future successful technology adop-

tions. First, relationships must be collaborative, coproductive, and based on transparent communication. The quality of these relationships is important for determining the quality of the organization,<sup>68</sup> and such relationships can be achieved through both long- and short-term actions.<sup>69</sup> Long-term actions begin with DHS leadership, and it will be important that they support collaborative relationships and model that behavior. Additionally, employees must develop the skills necessary to collaborate before they can be expected to build relationships. Building collaboration around preexisting and positive connections can accelerate a team's establishment of trust.

Another aspect to collaboration is the cocreation of ideas, designs, and implementation approaches for new technologies. Including intended users in this process allows DHS to integrate operational needs and cultural sensitivities so that adopted technologies reflect what DHS components need and what they are willing to accept.

Finally, ensuring that employees have clarity of organizational expectations and their associated roles in technology adoptions is crucial for collaboration. This clarity can be achieved only through transparent communication.

Aside from developing collaboration skills, employees need to develop skills to understand and use new technologies. This education and training should be deliberately and systematically designed to target anticipated technologies, intended users, and intended outcomes. Learning opportunities should also be designed and deployed thoughtfully, with employees provided with protected time to complete training and offered numerous formats for learning (e.g., online courses, seminars, hands-on experience, and ongoing mentorship).<sup>70</sup> By creating a culture of learning around technology adoption, DHS would, in turn,

reduce technology skill gaps and improve its workforce's ability to adopt technologies and integrate them into its workflows without unnecessary delay.

Even with well-planned and well-executed education and training, the success of technology adoption can be nonlinear, and unexpected user issues can arise. For some users, the anticipation of potential issues might be a deterrence to embracing new technology in their tasks and workflows. Therefore, leadership in DHS headquarters and components should foster an environment that is tolerant of these issues, in which user issues and subsequent impacts to routine operations are expected and accepted. Guiding users through an initial adoption period in a nurturing and forgiving environment can reduce users' reluctance to adopt new technologies. This environment can include a safe space to test and learn the new technology, on-demand support and contingency plans for when issues arise, and a forgiving organizational attitude should failure occur.

## **Final Thoughts on Reaching a Future State**

The three future states are ideal environments in which DHS is able to navigate the development and adoption of technologies for its organization in a more unified, streamlined, and successful way. These end states should be treated as ideals that can guide DHS's decisions around policy and governance, and ultimately, the organizational change that is required to achieve these envisioned futures.

Although each cover story is independent, the three futures represented in these stories are complementary. The unified plan for technology adoption provides a vision



for what IRD efforts are seeking to achieve and describes the means for getting there. The One Technology, Many Missions initiative focuses on developing and reinforcing the collaborative relationships needed to harness the capabilities of emerging technologies in support of multiple DHS missions. Finally, a supportive organizational culture fosters strong relationships and ensures that technology research can be successfully transferred into operational capabilities.

## Crosscutting Themes

In addition, several common themes emerged in all three cover stories as desired end states.

### Cross-Component Collaboration

Cross-component collaboration is essential to ensuring that research efforts can have the broadest possible impact across the department. Such collaboration is also essential to creating a coherent strategy, implementation plan, and road map that has the buy-in and support of all the components. Finally, cross-component collaboration is necessary for enabling a culture that promotes success in developing and adopting technologies across the organization. This collaboration needs to be supported by DHS headquarters and component leadership, and processes to facilitate collaboration need governance mechanisms and accountability for all participants involved.

### Collaboration with External Partners

Collaboration with external partners can contribute to the identification, development, and integration of technologies that can be used across DHS. A unified, published

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The end states should be treated as ideals.

strategic plan, implementation plan, and road map can enhance external collaboration by providing clear information about research priorities, component needs, and on-ramps for engagement across the U.S. government, industry, and academia. A culture of collaboration and cocreation can also benefit from engagements not only within DHS but across departments and with external industry and academic partners.

### Defined Roles and Responsibilities

Defined roles and responsibilities provide clear points for engagement either across components or with external partners. This is critical for individuals to know how to reach across components to find common cause or shared interests or to identify potential collaborations. Having clearly defined roles and responsibilities should help anchor the IRD strategy, implementation plan, and road map to ensure that all parties understand how their individual and collective efforts contribute to IRD outputs that help DHS achieve its desired mission and goals.

A culture that values transparent communication from leadership across all levels of the organization is necessary for individuals to have clarity in their roles and responsibilities, especially as those roles and responsibilities evolve with organizational change.

## Sustaining Organizational Change

Increasing DHS’s organizational flexibility, collaboration, and appetite for risk is necessary for advancing along the described pathways toward the end states. Establishing new ways of working and thinking in support of these organizational changes is important for building momentum for short-term impacts, but their long-term sustainment is also important for reaching future states that can endure. Sustaining organizational change can be possible if the department invests in a variety of influencing factors, including the following:

- leadership that provides a clear and consistent vision with goals that are purposeful, challenging, and aligned with DHS’s values
- individual competency that matches what the change requires of them and their commitment to that change
- processes that are well-suited to the organization and internally supported, such that individuals champion the diffusion of change across the organization beyond its initial implementation.<sup>71</sup>

Through these efforts, DHS can become a leader among federal departments in developing and adopting technologies in support of the department’s diverse missions and operations.

## Notes

- <sup>1</sup> Office of Inspector General, *Major Management and Performance Challenges Facing the Department of Homeland Security*.
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- <sup>3</sup> Poister, “The Future of Strategic Planning in the Public Sector.”
- <sup>4</sup> Kantabutra, “What Do We Know About Vision?”
- <sup>5</sup> Nagji and Tuff, “Managing Your Innovation Portfolio.”
- <sup>6</sup> Cochran, David, and Gibson, “A Framework for Developing an Effective Mission Statement.”
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- <sup>19</sup> Sull, Homkes, and Sull, “Why Strategy Execution Unravels—and What to Do About It.”
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<sup>21</sup> For example, the six goals listed in the *DHS Strategic Plan Fiscal Years 2020–2024* to counter terrorism and homeland security threats, secure U.S. borders and approaches, secure cyberspace and critical infrastructure, preserve and uphold the country’s prosperity and economic security, strengthen preparedness and resilience, and champion the DHS workforce and strengthen the Department (U.S. Department of Homeland Security, *The DHS Strategic Plan Fiscal Years 2020–2024*).

<sup>22</sup> U.S. Department of Homeland Security, Science and Technology Directorate, *Technology Centers Research Agenda*.

<sup>23</sup> U.S. Government Accountability Office (GAO), *Defense Science and Technology*; Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>24</sup> Criado, Alcaide-Muñoz, and Liarte, “Two Decades of Public Sector Innovation.”

<sup>25</sup> Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>26</sup> Ediriweera and Wiewiora, “Barriers and Enablers of Technology Adoption in the Mining Industry.”

<sup>27</sup> Ward, *Technology Adoption at Public Agencies*.

<sup>28</sup> Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>29</sup> Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>30</sup> Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>31</sup> GAO, *Defense Science and Technology* and Lopes and Farias, “How Can Governance Support Collaborative Innovation in the Public Sector?”

<sup>32</sup> Ediriweera and Wiewiora, “Barriers and Enablers of Technology Adoption in the Mining Industry.”

<sup>33</sup> Giesecke, “The Contrasting Roles of Government in the Development of Biotechnology Industry in the US and Germany.”

<sup>34</sup> Criado, Alcaide-Muñoz, and Liarte, “Two Decades of Public Sector Innovation”; Ediriweera and Wiewiora, “Barriers and Enablers of Technology Adoption in the Mining Industry”; Giesecke, “The Contrasting Roles of Government in the Development of Biotechnology Industry in the US and Germany”; Etkowitz, “Innovation in Innovation”; and Leydesdorff and Meyer, “The Triple Helix of University-Industry-Government Relations.”

<sup>35</sup> U.S. Department of Homeland Security, Science and Technology Directorate, “Industry Partnerships”; U.S. Department of Homeland Security, Science and Technology Directorate, “Office of University Programs.”

<sup>36</sup> Ediriweera and Wiewiora, “Barriers and Enablers of Technology Adoption in the Mining Industry.”

<sup>37</sup> Roberts and Schmid, “Government-Led Innovation Acceleration” and Kotila et al., *Strengthening the Defense Innovation Ecosystem*.

<sup>38</sup> Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>39</sup> Sanchez, “Strategic Product Creation” and Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>40</sup> Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>41</sup> See, for example, U.S. Department of Homeland Security, *The DHS Strategic Plan Fiscal Years 2020–2024*; U.S. Department of Homeland Security, *S&T Innovation Strategy 2017*; and U.S. Department of Homeland Security, *S&T Strategic Plan 2021*.

<sup>42</sup> Criado, Alcaide-Muñoz, and Liarte, “Two Decades of Public Sector Innovation”; Ediriweera and Wiewiora, “Barriers and Enablers of Technology Adoption in the Mining Industry”; Lopes and Farias, “How Can Governance Support Collaborative Innovation in the Public Sector?”; and Van Dijck and Steen, “Collaborating for Innovation.”

<sup>43</sup> Van Dijck and Steen, “Collaborating for Innovation.”

<sup>44</sup> Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>45</sup> Roberts and Schmid, “Government-Led Innovation Acceleration.”

<sup>46</sup> Van Dijck and Steen, “Collaborating for Innovation.”

<sup>47</sup> Baker, “The Technology–Organization–Environment Framework”; Sanchez, “Strategic Product Creation”; and Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>48</sup> Wegrich, “The Blind Spots of Collaborative Innovation.”

<sup>49</sup> Saghafian, Laumann, and Skogstad, “Stagewise Overview of Issues Influencing Organizational Technology Adoption and Use.”

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## About the Authors

**Katie A. Wilson** is an associate policy researcher at RAND. She has expertise in severe weather operational decisionmaking, experiment design, technology test and evaluation, and user-centered research. Wilson has a Ph.D. in meteorology.

**Jeff Anderson** is an associate policy researcher at RAND. His current research interests include climate change adaptation and mitigation, disaster recovery, energy, resilience, security, supply chains and logistics, and technology management. Anderson has a Ph.D. in engineering and public policy.

**Bianca Espinosa** is an associate physical scientist at RAND. She is a chemical biologist with technical training in organic synthesis, drug development, molecular biology, and genetics and experience in policy issues related to biotechnology and bio-security. Espinosa has a Ph.D. in chemistry.

**Jonathan L. Brosmer** is an associate physical scientist at RAND. His research focuses on force modernization, logistics, command and control, and cyber. Brosmer has a Ph.D. in chemistry.

**Kristin Van Abel** is a senior technical analyst at RAND. Her research focuses on energy and environmental policy, Arctic policy, critical infrastructure, national security, and strategic and long-term planning. Van Abel has a M.S. in environmental science and management.

**Eric Landree** is a senior engineer at RAND. His areas of research include research and development strategic planning, research and development program evaluation, and threats associated with emerging technologies. Landree has a Ph.D. in materials science and engineering.

## About This Paper

The purpose of this paper is to help support the development of the U.S. Department of Homeland Security (DHS) Innovation, Research, and Development Strategic Plan. The project included providing supporting research and analysis and the design, planning, and execution of a DHS-wide workshop to solicit input from across the DHS components to inform the development of the inaugural DHS Innovation, Research, and Development Strategic Plan.

This document describes three desired future states for DHS with regard to innovation, research, and development. These desired future states describe idealized future versions of DHS to identify and overcome the challenges and steps necessary for DHS to make progress toward reaching the desired future state.

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