



Closing the Defense Innovation Readiness Gap

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The Munich Security Conference (MSC) is the world's leading forum for debating international security policy. In addition to its annual flagship conference, the MSC regularly convenes high-profile events around the world, publishes the annual Munich Security Report, and engages in manifold other activities to draw attention to pressing security challenges and possible solutions.

MSC's Security Innovation Board is tasked to connect the worlds of technological innovation and political decision-making in order to recognize the chances and challenges related to technological progress and come up with clear policy priorities earlier and in a more coordinated manner.

CONTENTS

04.

Introduction

20.

Action 5

Deliberately
shape the defense
innovation market

05.

**Study and
Findings**

22.

Conclusion

07.

Action 1

Define your unique role
in the global innovation
landscape

22.

Appendix

Survey methodology

10.

Action 2

Communicate a clear
innovation ambition and
align incentives

24.

**Model Specific
Recommendations**

13.

Action 3

Actively manage your
innovation portfolio

34.

About the Authors

16.

Action 4

Prioritize developing
meaningful innovation
partnerships



Closing the Defense Innovation Readiness Gap

Ministries of defense can take
five actions to close their
innovation readiness gap

Introduction

For the past ten years, much like corporations, ministries of defense (MoDs) have reported innovation as one of their top priorities, citing it as a key driver of geopolitical standing and operational advantage. Typically, this prioritization manifests in the ministries' pursuit of several innovation best practices, including Silicon Valley "learning tours," high-profile partnerships with brand-name companies and universities, reorganized innovation offices and investment hubs, and newly appointed chief innovation roles and officers.

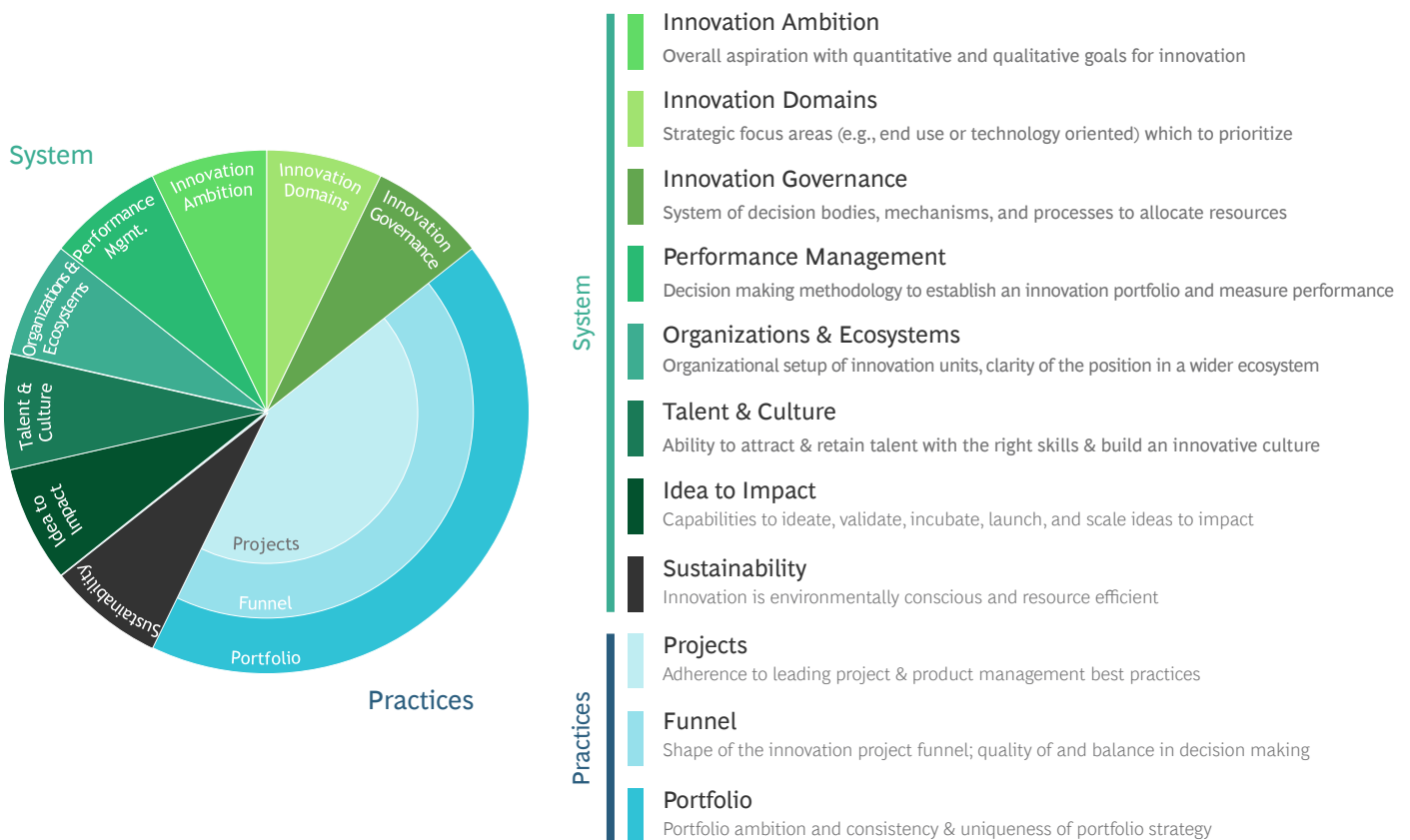
Yet, despite their best intentions and considerable investment, many ministries, and the national legislatures and leaders that oversee them, remain dissatisfied with the results that these innovation best practices have produced. MoD leaders are beginning to recognize that a significant gap—an **innovation readiness gap**—exists between their aspirations for innovation and their ability to generate results. While seeking to foster and scale innovation at the rate and investment levels necessary to maintain the comparative advantage that they desire against their peer and near-peer competitors, MoDs are still struggling to understand and apply the critical dimensions of how best to pursue innovation and close the innovation readiness gap that exists.

Study and Findings

In Fall 2021, the Munich Security Conference Innovation Board (MSC) and Boston Consulting Group (BCG) undertook a comprehensive review of defense ministries' innovation activities across the globe to understand and better explain the fundamental issues inhibiting defense innovation today. Leveraging BCG's extensive private sector innovation experience across sectors (including defense

and security), the joint MSC-BCG study team initiated its first annual study of defense innovation around the world with a survey sent to 59 ministries of defense, plus the European Union and NATO. Survey questions yielded scores that allowed for the comparison of innovation readiness of MoDs in relation to their private sector counterparts along the 11 core dimensions of innovation. (See Exhibit 1.)

Exhibit 1 The 11 Innovation Readiness Dimensions



Sources: BCG Most Innovative Companies study, 2021; BCG analysis.

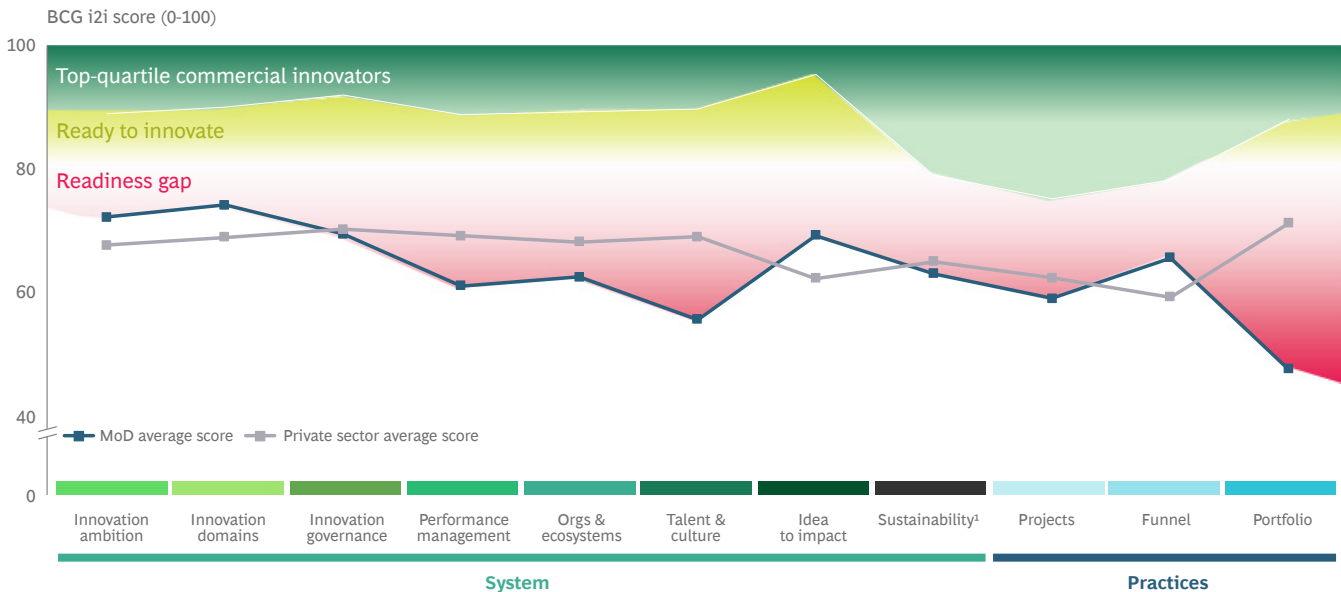
This survey was complemented with interviews of key global public and private national security leaders. The team also created a fact base including more than 40 separate indicators of MoDs' approach to defense innovation. (See "Appendix: Survey Methodology", page 22.)

The study confirms not just that the innovation readiness gap exists, but also that it is prevalent. Ministries of defense face significant challenges on all 11 dimensions of innovation readiness. As seen in

Exhibit 2, there are no MoDs whose innovation readiness matches that of the top tier of the private sector (as shown in green). Nor do any of their scores extend past the threshold of basic innovation readiness, defined as having enough capabilities to innovate confidently on an ongoing basis (the red area represents the "readiness gap".) On average, MoDs scored 61.8 against a threshold score of 80. For 7 of the 11 dimensions, MoD scores also fell below the private sector benchmark average.

Exhibit 2

MoDs Report Opportunities to Improve in Innovation Readiness



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

¹ The dimension Sustainability will be added to the Most Innovative Companies study beginning in 2022. The commercial benchmark was imputed from BCG's sustainability work.

Ministry leaders may not be surprised to learn that they fall below private sector benchmarks in most of these 11 dimensions, but they should be inspired to action by the quantification of this gap. Based on BCG's prior research on highly innovative organizations, these scores indicate that most MoDs currently lack the organization, structures, focus, ambition, and talent to effectively innovate at scale.

Further, MoDs cannot rely on private sector innovation to provide the capabilities needed to maintain or regain technological advantages. MoDs are in a unique position to influence the defense landscape by recognizing the demand for innovation in their forces, aggregating that demand, and scaling up new technologies to meet it. As long as ministries continue to fall short in these activities, the innovation gap will persist.

What, then, must be done?

While many actions were identified to potentially improve individual innovation dimensions, the BCG-MSC team synthesized the most impactful results into five overarching actions that each ministry of defense may take to deliver an immediate, consequential reduction in the defense innovation readiness gap. Each action is supported by two near-term, tailorable recommendations so each individual ministry can implement its own country-specific context. Although ministry priorities or specific readiness gaps may dictate the immediate prioritization of some actions over others, all actions can be implemented over time to scale innovation and achieve a military edge.

The actions that each ministry of defense can take to further close the defense innovation readiness gap include:

- 1 Define your unique role in the global innovation landscape.** Choose your innovation model based on your country's strategic advantages. There is no one one-size-fits-all approach.
- 2 Communicate a clear innovation ambition and align incentives.** Establish a clear innovation ambition, define focus areas, and prepare your workforce with tools and training. Retaining and attracting top talent requires a clear mandate, a common purpose, and reinforcing incentives.
- 3 Actively manage your innovation portfolio.** Set outcome-focused KPIs, track program success, and shift from a focus on individual project silos to a balanced, holistic, and robust project pipeline.
- 4 Prioritize developing meaningful innovation partnerships.** Establish governance and structure to maximize the value of existing and future partnerships in the organization's ecosystem. Shift focus from just adding partners to also increasing the value from existing partnerships and non-traditional defense stakeholders.
- 5 Deliberately shape the defense innovation market.** Influence investments through market signaling, aggregating demand, and employing open architectures and open systems.

Action 1

Define your unique role in the global innovation landscape

Historically, many ministries of defense followed the same broad approach to innovation by focusing on the acquisition of major weapons platforms, closed systems, and partnerships formed with the traditional defense industrial base.

This approach shaped the structure of the global defense industry, which is still in place today. A few large, industrial nations spend considerable sums of money with traditional defense vendors. More often than not, they award long-term, sole-source contracts to individual suppliers, each for a specific capability. This places the nations in a long-term “vendor lock” with the supplier. Subsequent innovations and improvements to the purchased system or platform become costly, slow to be delivered, and often realized at the discretion of a sole supplier. Meanwhile, smaller nations seek to piggyback off the larger nations, buying legacy platforms through the foreign military sales process that may be multiple generations behind current technology.

The traditional approach is proving highly antiquated in the emerging global context. Today technological innovation is diffuse and widespread, and hardware-based defense technologies are giving way to software-based systems. Furthermore, the traditional approach fails to recognize the specific context and comparative advantages that enable each MoD to contribute in its own way to global defense innovation.

Today, there is no one-size-fits-all approach to innovation; we have to counter this antiquated mindset. To meet the current nature of innovation, MoDs must define their own role in the global innovation landscape by selecting an innovation model that fits their unique, comparative advantages and enables their optimal outcomes.

Building upon extensive research in the private sector, we identified five distinct models of defense innovation that ministries can adopt. The effectiveness of these models is supported by a rigorous statistical analysis performed on a fact base of publicly available ministry statistics. (See “Appendix: Survey Methodology,” page 22.)



	Creators and Expanders	Nations that focus on “big bet” efforts to create new, disruptive capabilities and expand into new technologies Comparative advantage: Significant private and public capital
	Solution Builders	Nations that base innovation on end user needs and feedback Comparative advantage: Superior end user insight
	Fast Adopters	Nations that rapidly tailor, improve upon, and scale others’ innovation practices Comparative advantage: Rapid learning and agility
	Deployers	Nations that maximize value from other nations via efficient, timely procurement through multilateral and bilateral agreements Comparative advantage: Efficient procurement and nation partnership
	Specialists	Nations that develop specialized focus in key technology domains of comparative advantage Comparative advantage: Superior insight into few domains

Exhibit 3

Choice of Innovation Model Depends on MoDs' Characteristics and Comparative Advantages



Creators and Expanders

Focus on “big bet” efforts to create new capabilities



Solution Builders

Base innovation on end user needs and feedback



Fast Adopters

Rapidly tailor and scale others' innovation practices



Deployers

Maximize value from other nations via procurement



Specialists

Develop specialized focus in key technology domains

Comparative Advantage

Significant private and public capital

Superior end user insight

Rapid learning and agility

Procurement and nation partnership

Superior insight into few domains

Key Characteristics

Nations with a large amount of defense spending

Blended innovation approach including incremental and “big bet” efforts

Focus on leveraging end-users feedback throughout entire product life-cycle

Blended innovation approach; emphasis on small bets

Import and adapt successful innovation practices

Emphasis on rapid innovation identification and improvement

Focus on innovative procurement processes and partnerships

Strategic, focused investments in locally driven innovation

Focus R&D efforts on a few key tech domains

Leverage strong venture economy to drive focused public and private innovation

Measurable Outcomes

Enhanced capabilities in disruptive technology

High satisfaction scores and adoption rates by end users

Speed of adoption and number of continuous improvement initiatives

Technologies and equipment imported, purchased, and fielded

Patents and perceived leadership in selected areas

Example Nations

China; United States

South Korea; United Kingdom

India; Turkey

Qatar; Thailand

Estonia; Israel

Sources: BCG Defense Innovation Survey; fact base of 40 publicly available key indicators; BCG analysis.

The map in [Exhibit 4](#) shows the 59 ministries of defense covered in our study according to the model that fits them best. Countries were statistically sorted into one of the five models based on 40 key indicators. (See “[Appendix: Survey Methodology](#),” page 22.) Five countries fall into two classifications: Denmark, Egypt, Japan, Pakistan, and Switzerland. Ten countries could not be classified, because of conflicting indicators. This could be the result of ministries employing more than one innovation model, or it could represent an ongoing transition between models.

For ministries currently pursuing more than one model, developing new, disruptive capabilities may be feasible, but only with added complexity. A single model will tend to reduce duplication of effort among ministry innovation agencies, provide focus for R&D funds, help streamline acquisition and procurement efforts, and provide clear direction and guidance to the ministry workforce.

Exhibit 4

Countries Were Classified Into Five Innovation Models

Creators and Expanders



China, Russia, United States

Solution Builders



Australia, Austria, Canada, Denmark, France, Japan, South Africa, South Korea, Switzerland, UAE, United Kingdom

Fast Adopters



Brazil, Czech Republic, Denmark, Egypt, Finland, India, Malaysia, Saudi Arabia, Spain, Sweden, Turkey

Deployers



Albania, Bulgaria, Croatia, Egypt, Georgia, Greece, Indonesia, Japan, Kenya, Latvia, Montenegro, Mexico, Nigeria, North Macedonia, Pakistan, Philippines, Poland, Qatar, Romania, Slovakia, Thailand, Vietnam

Specialists



Argentina, Estonia, Israel, Lithuania, Pakistan, Portugal, Switzerland

Undefined



Belgium, Germany, Hungary, Italy, Luxembourg, Netherlands, Norway, Singapore, Slovenia, Ukraine

Sources: BCG Defense Innovation Survey; respondents include 59 ministries of defense; fact base of 40 publicly available key indicators; BCG analysis.

Recommendation 1A

Select a defense innovation model guided by your nation's unique, comparative advantages. Deliberately select one of the five defense innovation models as a blueprint for closing the innovation readiness gap and achieving your desired place in the global defense innovation landscape.

Recommendation 1B

Establish a more inclusive definition of innovation based on your selected model. Articulate a more inclusive definition of defense innovation that embraces emerging and disruptive capabilities, focuses on outcomes, and expands the potential pool of innovation partners beyond the traditional defense industrial base (e.g., engaging suppliers in health care, advanced manufacturing, and textiles).

Recommendation 1B:

Establish a more inclusive definition of innovation based on your selected model

Two examples of implementation

Creators and Expanders

Identify disruptive technologies and enablers (including those outside the traditional defense base) and integrate innovations from a variety of sectors.

The United States has identified that advanced, heat-resistant materials are key components. It is partnering with private sector companies that are not usually included in traditional definitions of its defense industrial base.

Deployers

Identify the leading domestic industries in your country and create policies that require engagement of those industries in defense innovation efforts.

North Macedonia identified the strength of its textile industry as a possible source of innovation. The MoD partnered with industry and academia to develop the country's first domestically produced, multifunctional uniform for its military.

Action 2

Communicate a clear innovation ambition and align incentives

MoDs highlighted meaningful gaps in innovation ambition and talent readiness driven by two challenges. First, innovation priorities are often unclear. Second, MoDs lack incentive structures that reward employees who pursue innovation goals within the ministry.

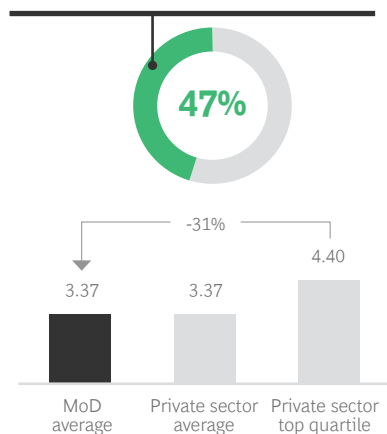
Although competition for regional hegemony has increased, most MoDs are not clearly articulating their ambition. Only 47% of survey respondents felt that “our goals for innovation are clearly defined/articulated,” 57% believed their “innovation goals are a strategic priority for top leadership,” and 62% felt their “role in advancing innovation is clearly defined.” All of these responses fell below private sector benchmarks and well below the top quartile of their private sector counterparts. (See Exhibit 5.)



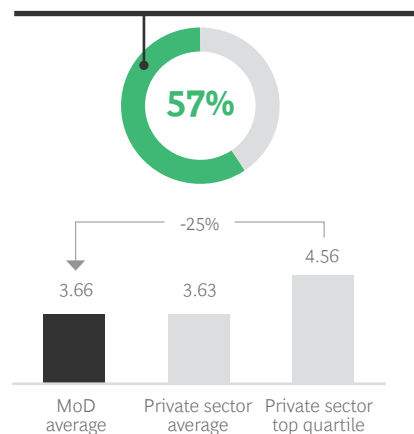
Exhibit 5

Gaps in Ambition as Reported by MoDs

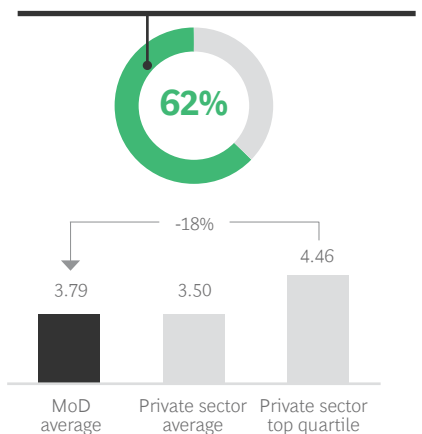
47% report goals for innovation are clearly defined/articulated



57% report innovation goals are a strategic priority for top leadership



62% report their role in advancing innovation is clear and defined



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

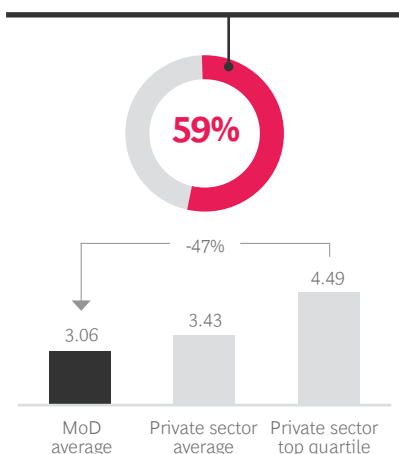
Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

These findings are particularly problematic for MoDs in view of the vital link between ambition and talent recruitment and retention. Survey findings confirmed that this talent readiness gap exists: 59% of survey respondents did not feel the innovation team is “designed to be an

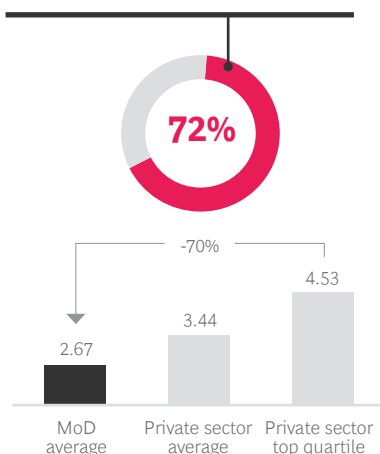
attractive destination for the best talent,” 72% indicated that ministry staff are not rewarded for pursuing innovation within their ministries, and 64% reported not having “an innovative culture that encourages risk taking and does not punish failure.” (See Exhibit 6.)

Exhibit 6 Gaps in Talent as Reported by MoDs

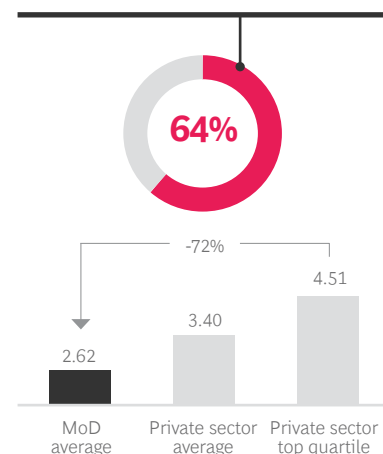
59% report the innovation team and its setup are not designed to be an attractive destination for the best talent



72% report employees are not rewarded in a timely manner for pursuing new, innovative ideas



64% report there is not an innovative culture that encourages risk taking and does not punish failure



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

MoDs risk undercutting the significant and recent efforts made to attract and retain top talent if they do not more clearly articulate an ambition and create supporting incentives for the talent to pursue that ambition. Organizational redesign is not enough to create an innovative culture; individual incentives for innovative behavior are needed. For instance, while ministries offer a unique sense of mission that will help bring some top talent through the door, BCG’s studies of digital talent indicate that today’s prospective recruits (especially

those in highly innovative sectors) want different types of incentives to remain with their employers. These incentives are not always available in the deeply hierarchical and process-driven structures of most MoDs.

MoDs will need to take specific actions to address the current challenges facing their innovators. Simply stating an innovation ambition is not sufficient unless the organizational talent is capable of hearing, internalizing, and acting on the ambition. We propose two actionable recommendations as a starting point below.

Recommendation 2A

Clearly articulate ambition in an understandable and personalized manner. Widely communicate your innovation ambition across the ministry. Include strong, visible support from military and political leadership. Tailor the number and type of domains based on innovation model, and describe the organizational structure, personnel, funding, and authorities that will be allocated to support. Ensure that individuals at all levels of your organization can understand and interpret that ambition with an explicit personal link to how that ambition affects their day-to-day role, with reinforcing workflow tools, training, and communication campaigns.

Recommendation 2A: Clearly articulate ambition in an understandable and personalized manner

Two examples of implementation

Deployers

Instead of focusing on specific technologies, establish overall procurement excellence. Train people in the innovation model so that procurement and deployment of innovative technology happens throughout the organization. Promote the value of frugality and “punching above our weight,” and the wisdom of building strong alliances with technologically adept nations.

Thailand’s explicit decision to pursue “major non-NATO ally” status with the US gives it access to cutting-edge technology from allies that spend five times what Thailand spends on R&D.

Specialists

Assess areas of strength within the venture economy and align R&D domains to one or two high-technology domains. Match strengths with these innovative firms and ensure complementary R&D efforts. State your key ambition as seeking to sustain technological superiority in these areas.

Estonia’s MoD selected its innovation domains based on the country’s commercial proficiency in cybersecurity, artificial intelligence, robotics, digital health, and information and communications technology. The MoD seeks to remain a leading innovator in these fields as long as they remain strong sectors of the venture economy.

Recommendation 2B

Retain and recruit top talent by incentivizing innovative behavior. MoDs should foster an innovation-friendly, risk-taking culture. The MoD should offer a broad range of incentives that emphasize recognition, autonomy, compensation, flexibility, and rapid promotion for successful risk-takers who achieve disruptive innovation. While the research team identified examples of this recommendation in many nations, the vast majority of MoDs still tend to rely on legacy evaluation systems and approaches (such as “fitreps” and promotion boards) rather than incentivizing innovative behavior.

Recommendation 2B: Retain and recruit top talent by incentivizing innovative behavior

Three examples of implementation

NATO received over 12,000 applications for 20 positions in its new Young Professional Programme (YPP). YPP emphasizes a sense of purpose and offers recruits flexible opportunities through three one year rotations in different NATO bodies.

Specialists

Create a pipeline program with universities to recruit and integrate top student talent into innovation organizations focused on one or two key domains.

Israel has two programs that provide specific incentives to attract STEM talent from elite universities. The programs are highly competitive and those accepted can receive up to nine years of technical, classified training. They have a high level of autonomy and are assigned to innovation agencies and Israel Defense Forces (IDF) line units. Recruits help directly inform key policy decisions related to their domains of study.

Creators and Expanders

Institute a performance evaluation system that explicitly rewards risk-taking behaviors, including moonshots. This can include accelerated promotions, monetary incentives, choice assignments, and increased autonomy over spending. Give employees who successfully develop technology breakthroughs managerial autonomy over R&D related to those projects.

Amazon deliberately curates a culture of risk-taking among its employees and leaders by making an assessment for risk-taking part of its interview process and reinforcing this attribute in annual performance reviews and promotion policies that reward successful risk-taking.

Action 3

Actively manage your innovation portfolio

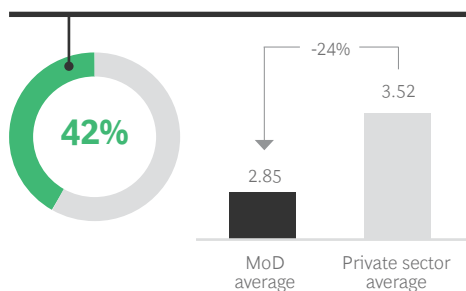
While many MoDs initiate and maintain a plethora of innovation activities, MoDs do not tend to evaluate the progress and value of those activities efficiently. Indeed, most MoDs have limited experience in performance measurement overall. As shown in Exhibit 7, 42% of the respondents reported that they use metrics or key performance

indicators (KPIs) for innovation readiness, and only 45% have established value criteria for their acquisition, prototyping, or innovation projects. Without clear metrics defining success, it is difficult to assess progress accurately or hold teams accountable for true outcomes.

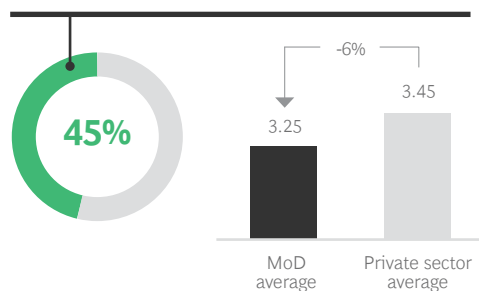
Exhibit 7

MoDs Report Gaps in Defining and Measuring Project Value and Success

42% report innovation metrics/ KPIs are clear and defined



45% report project value criteria are defined/measured



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

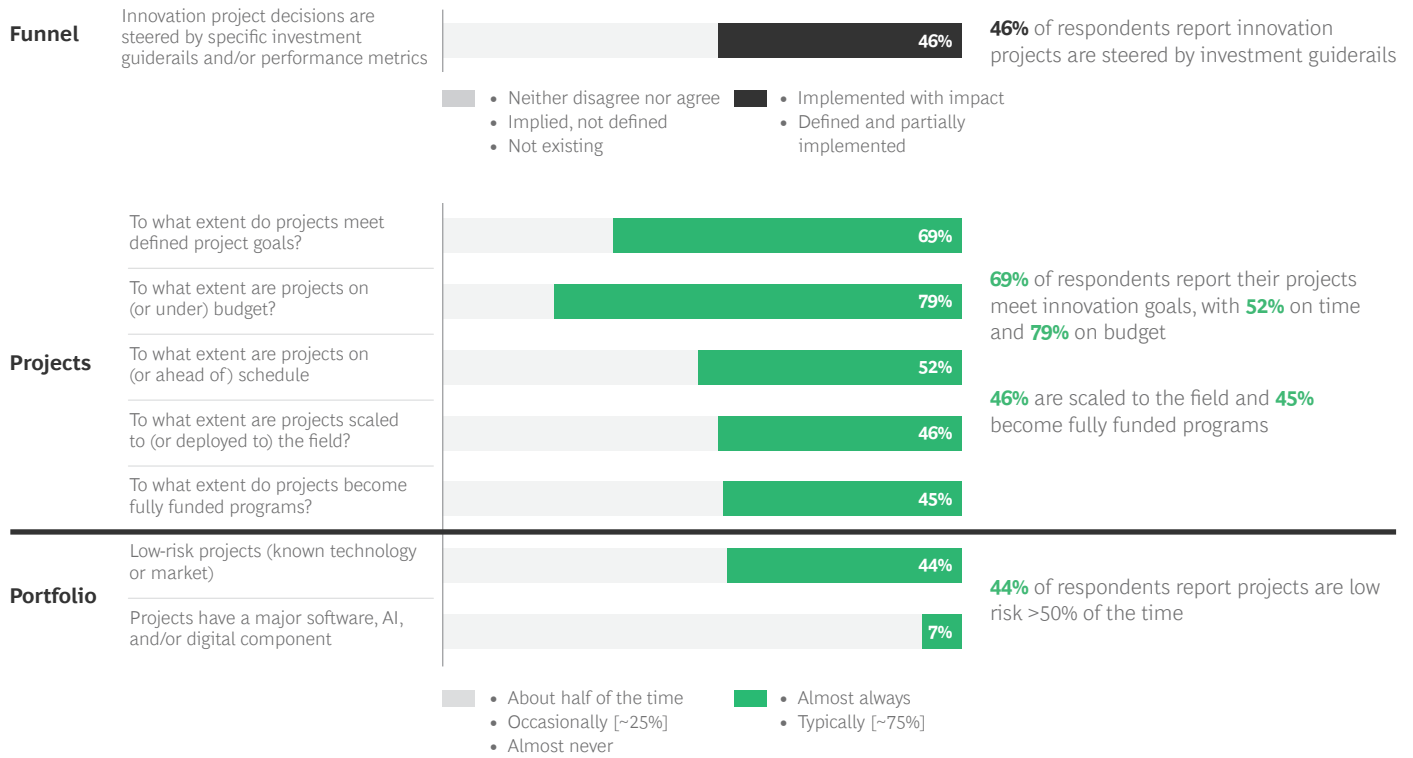
Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

Further, 54% of respondents report a lack of specific investment guiderails and performance metrics to steer R&D and innovation project decisions across the broad portfolio of a ministry's R&D investments. (See Exhibit 8.) Without the ability to evaluate the entire R&D portfolio of a military service or the ministry, MoDs tend to overemphasize the risk of individual acquisition failures.

MoDs can address this problem by actively treating the totality of their R&D investments as a portfolio, rather than just a collection of individual projects. Over time, MoDs can consciously develop a diversified suite of capabilities that can continually produce results, even if an individual project or platform fails.

Exhibit 8

MoDs Report Projects to be on Schedule, on Budget, and Incremental



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

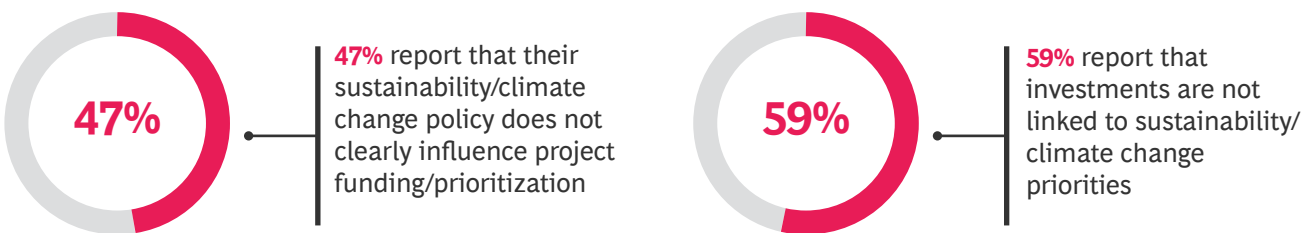
Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

An emerging ambition regarding climate and sustainability innovation surfaced in several of the stakeholder interviews and in research on MoD practices. However, survey results indicate that this ambition has not yet taken hold. Specifically, 47% of respondents said that sustainability was not a major influence on innovation priorities, and 59% said that investments are not linked to sustainability or climate change. (See Exhibit 9.)

The recommended actions involve evaluation of performance and using performance insights to manage the innovation portfolio. Once again, the specifics vary based on the innovation model that the MoD has adopted.

Exhibit 9

MoDs Report Gaps in Linking Sustainability and Innovation Practice



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

Recommendation 3A

Define and track outcome-based metrics. Move beyond evaluating process to using outcome-based KPIs as part of a ministry-wide performance management framework to ensure accountability by defining and quantifying successful innovation. Go farther with tiered metrics that enable isolation of performance issues and ensure accountability.

Recommendation 3B

Take a holistic approach to innovation portfolio management with clear investment guiderails and regular review. Ensure a diverse portfolio (e.g., with both low- and high-risk projects) by adopting clear investment guidelines. These guidelines should focus funding on target domains, sustainability goals, and overall ambition. Avoid siloed thinking and evaluate risk across the entire R&D and/or innovation portfolio.

Recommendation 3A: Define and track outcome-based metrics

Two examples of implementation

■ Creators and Expanders

Establish and publish outcome-based metrics for all innovation projects. Examples include tracking the progress in scaling projects to the field, total cost of ownership (TCO), and full life-cycle assessment.

The US Department of Defense's National Security Innovation Network (NSIN) uses five outcome-based metrics, including ROI and fielding rate, to evaluate its prototyping and testing efforts with startups and academia.

■ Fast Adopters

Ensure technologies are adapted in a timely manner by emphasizing key performance indicators related to effectiveness and efficiency. Examples include speed of acquisition, improvement upon original practices, and consistency in tailoring technology to immediate needs. Also track metrics related to staff learning and development for adapting and scaling innovation.

India's Defense Innovation Organization (DIO) was modeled after the US Defense Innovation Unit (DIU). India refined the governance model to include private industry partners. By emphasizing metrics like ROI and speed, DIO has increased its contracting speed to surpass the US unit upon which DIO is based.

Recommendation 3B: Take a holistic approach to innovation portfolio management with clear investment guiderails and regular review

Two examples of implementation

■ Creator and Expanders

Balance short-term and long-term needs with a "70-20-10" mix of priorities. In this mix, 70% of the project allocations support incremental improvements in current core technologies; 20% support adjacent technologies or practices that have not yet been developed; and 10% are reserved for "big bets." Enforce funding allocations through quarterly reviews by the central governing body.

Google applies a strict 70-20-10 rule to assess and evaluate its investments in new product lines and businesses. The company leaders reinforce these investment guidelines through their own quarterly reviews.

■ Solution Builders

Set up a strategic innovation fund to capture emerging technologies that will meet user needs at every life-cycle stage. The fund should incorporate end user feedback from analytic centers throughout each stage of prototyping, testing, and evaluation.

Canada employs a Strategic Innovation Fund (SIF) to fund and evaluate prototypes at multiple stages of maturity. Each evaluation cycle involves testing end users and using their feedback to help guide further funding decisions.

Action 4

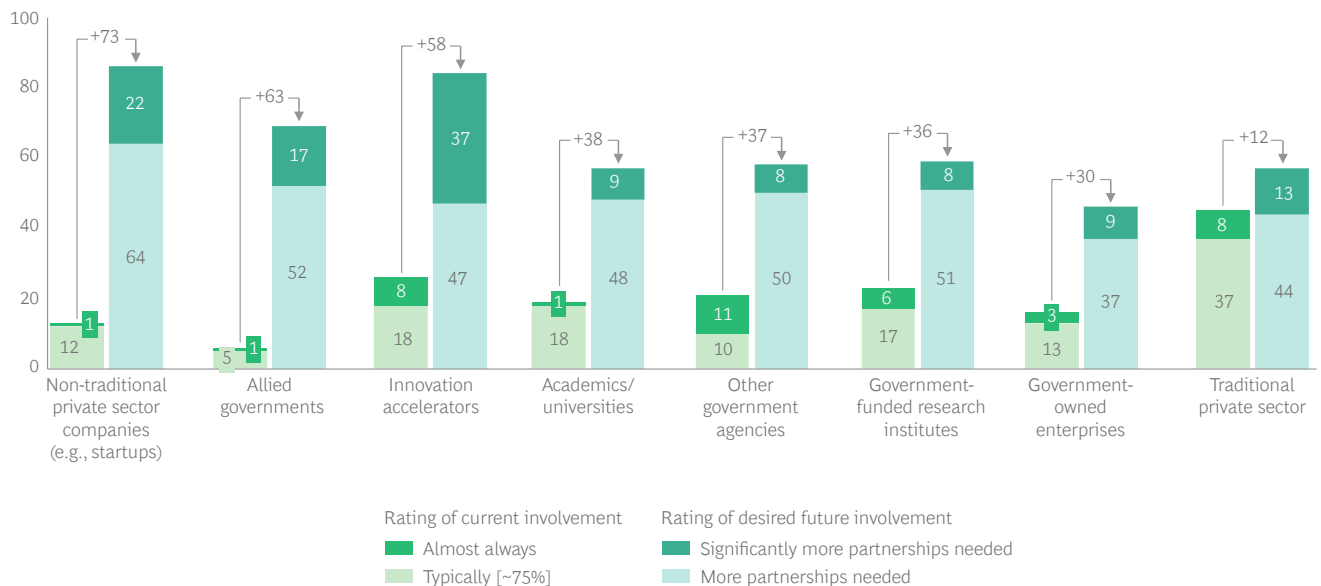
Prioritize developing meaningful innovation partnerships

Historically, many ministries of defense have enjoyed deep partnerships with domestic universities and companies within their local defense industrial bases. In recent years, a growing number of defense organizations have sought partnerships with incubators, accelerators, startups,

and international universities. It is not surprising that survey respondents consistently indicated the desire for more, and more robust, partnership arrangements with high-tech startups and innovation accelerators. (See Exhibit 10.)

Exhibit 10 MoDs Report Gaps in Desired Partnerships, Especially with Startups and Allied Governments

Current and desired level of involvement with partners (%)



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

However, this widespread desire for more partnerships must be balanced against the staggering number of existing partnerships already in place with industry, academia, and the venture community. MoDs have

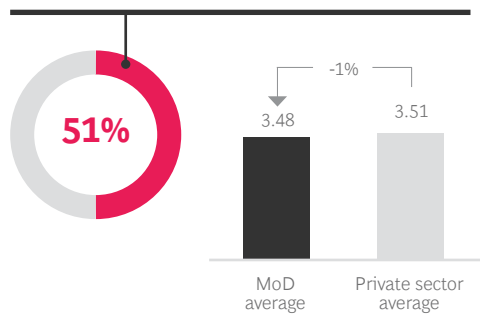
established many physical and virtual innovation hubs and organizations for innovation outreach in countries around the world. (See Exhibit 11.)

Management of partnerships is often viewed as cumbersome and outside MoDs' traditional comfort zone. A major inhibitor of effective innovation partnerships is the lack of a clear governance structure: 51% of respondents reported a lack of a central investment body to steer

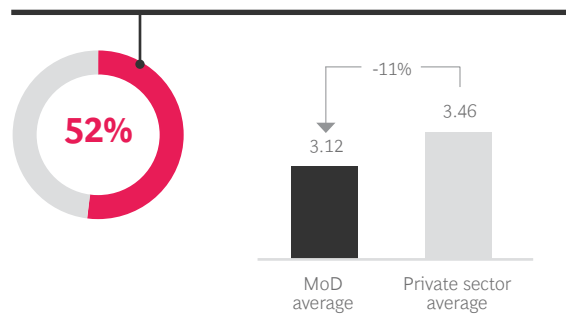
partnership funding, and 52% reported they didn't think there were any ways for their ministry to make direct investments in the very high-tech startups with which they sought increased interaction. (See Exhibit 12.)

Exhibit 12 MoDs Lack Governance and Defined Processes to Support Partnerships

51% report a lack of central investment bodies



52% report there is a lack of processes to direct investment into the local industrial base



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.



Although ministry respondents consistently cite the desire for more partnerships, they admit that their ministries lack the clear governance and policies to maximize the value of those partnerships. Two recommendations below address these issues.

Recommendation 4A

Establish a unifying central governance body for partnerships. This group should provide clear, unifying guidance on structuring partnerships (e.g., bilateral agreements) to achieve rapid, agile access to desired outcomes. Ensure operational relevance of these bodies by empowering them to regularly review and evaluate ministry partnerships for value. Further, use the central body to maintain awareness and syndication of existing and emerging innovation across the respective innovation ecosystem.

Recommendation 4B

Balance the mix of partnerships and align them to model-based outcomes. Deliberately structure the number and type of domestic and international partnerships to achieve specific outcomes based on your selected innovation model. Balance partnerships to include both traditional entities (e.g., alliances and OEMs) and non-traditional entities (e.g., deep-tech startups).

Recommendation 4A: Establish a unifying governance body for partnerships

Two examples of implementation

Solution Builders

Create a central innovation unit as a centrifuge for end user engagement. Set it up to govern a network of military, industry, academia, and venture capital stakeholders. Frequent engagement from top leadership will allow for rapid approval and deployment.

The United Kingdom's Joint Innovation Hub operates under the authority and direction of the commander of UK's Strategic Command. It serves as a consolidated entry point for non-traditional vendors (such as academic researchers and startups). They can interact directly with end users from the ministry and armed forces, and they are involved in prototyping advanced solutions to end user problems and capability gaps.

Fast Adopters

Categorize R&D requirements into two to four tiers based on need and complexity. This will help coordinate innovation efforts and clarify which should be homegrown versus which should be adopted from allies and partners.

Turkey has targeted its procurement efforts to reduce its dependency on other nations for major weapons platforms. Instead, it has made targeted investments in its local defense industrial base to build vehicles at home so that it can focus adoption efforts on emerging and disruptive technologies from partners abroad.

Recommendation 4B: Balance the mix of partnerships and align them to model-based outcomes

Two examples of implementation

Deployers

If not part of a major partnership such as NATO, seek favored status such as "major non-NATO ally" to increase access to more mature technology.

Mexico worked with the US to reorganize its longstanding bilateral partnership. The two countries launched the Merida Initiative in 2008. It fundamentally shifted the relationship in Mexico's favor. This initiative includes increased funding, training, military equipment, and military exports to the US, and reduced pricing by volume on imports to Mexico.

Specialists

Use formal bilateral partnerships with Creators and Expanders and Solution Builders to access technologies outside of key domains.

Argentina aspires to become a specialist in space systems and has developed bilateral relations with China to access technology and satellites in exchange for basing rights and land leasing. This provides Argentina technical access to cutting-edge space systems until it develops its own organic proficiency.

Action 5

Deliberately shape the defense innovation market

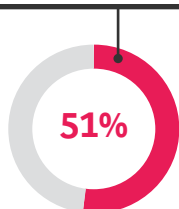
Traditionally, ministries of defense acquire emerging, disruptive technologies from the private sector through a “pull” method in which the private sector works to create new technologies that the ministries then select based on their specific needs. This approach can overemphasize a near-term

focus on requirements and may not fully account for future upgrades, emerging threats, or direct end user feedback. Survey respondents tend to agree; they reported that projects fail to consider TCO (51%), the future need for upgrades (51%), and user feedback and needs (47%). (See Exhibit 13.)

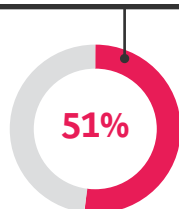
Exhibit 13

MoD Survey Results for Ideas to Impact Show Several Gaps in Practice

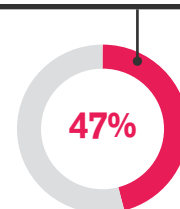
51% report TCO is not considered in idea validation



51% report the need for future upgrades is not considered



47% report user feedback is not considered



Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

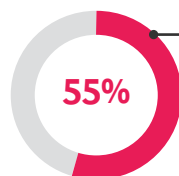
Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

Ministries with a traditional approach to acquisition often find that speed and agility suffer. Any system that is primarily reactive will struggle to achieve efficiency or effectively respond to emerging threats. 55% of

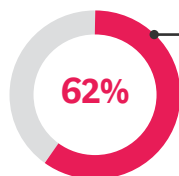
respondents report that acquisition policies do not enable fast and agile fielding, and 62% report a lack of defined processes to enable timely acquisition of new technologies. (See Exhibit 14.)

Exhibit 14

MoDs Report They Are Unable to Support Fast and Agile Fielding



55% report acquisition policies do not enable fast and agile fielding



62% report the lack of defined processes to enable timely acquisition of new technologies

Sources: BCG Defense Innovation Survey, 2021; BCG analysis.

Note: Results were benchmarked against the Most Innovative Companies study, with 2,249 commercial enterprises as respondents.

The lack of well-defined open architectures and modular systems can compound existing challenges in acquisition speed and proficiency. The design and development of major weapons platforms with little consideration for aggregated requirements or future upgradability can create a dependency on individual

sole-source providers, even when requirements are similar across platforms. This can lead to a “reinvent the wheel” approach as well as additional costs and operational inefficiencies for ministries and can reduce interoperability among both armed forces of the same country and international partners and allies.

Recommendation 5A

Proactively signal demand to spur private/public investment. Engage with non-traditional and traditional players throughout the entire life cycle to identify relevant technologies and signal their value to the broader marketplace (e.g., through direct prototyping investments). Develop mechanisms for identifying and communicating MoD use cases for emerging and disruptive technology, particularly early in the life cycle.

Recommendation 5B

Aggregate demand and employ open architectures/systems to increase the pace and efficiency of innovation: Align requirements and ensure commonality across technologies, platforms, services, and countries to reduce duplicative investments. Employ modular systems and open architectures to increase efficiency, reduce upgrade costs, and increase interoperability with allies and partners. Implement acquisition policies that protect IP for industrial base partners in an open system and emphasize rapid, agile procurement.

Recommendation 5A: Proactively signal demand to spur private/public investment

Two examples of implementation

In its own market-signaling effort, NATO established the Defense Innovation Accelerator of the North Atlantic (DIANA) in 2021. DIANA is a virtual startup accelerator that showcases the types of technology and startups that NATO and its alliance members are interested in. Even if an individual startup is not selected for an accelerator cohort, DIANA provides a clear signal to venture capital about the types of dual-use technologies best positioned to receive government funding.

Solution Builders

Co-locate private and public capital during technology demonstrations for end users.

The French Defence Innovation Agency (AID) hosts exhibits where private sector companies (including startups) can demonstrate their dual-use innovations to both the French military and private capital. Providing opportunities for private investors to directly observe end user enthusiasm for a particular technology or solution provides a clear signal of government interest. In 2018 alone, more than 160 technologies were demonstrated for end users and potential VC investors at AID-sponsored events.

Recommendation 5B: Aggregate demand and employ open architectures/systems to increase the pace and efficiency of innovation

One example of implementation

Creators and Expanders

Set a standard that all weapons platforms will have open architecture for components that increase interoperability within and across platforms.

The US Department of Defense implemented a Modular Open Systems Approach (MOSA) as its primary integrated technical and business strategy to manage and sustain systems that employ modular and open principles. MOSA employs components across weapons systems that are more easily removable, upgradable, and interoperable, and allow open competition from the private sector. US law now requires that all major defense acquisition platforms be designed and developed using a MOSA-based approach.

Conclusion

For each ministry of defense, the stakes for addressing the defense innovation readiness gap are higher than they might first appear. Clearly identifying and fixing this gap isn't about innovation rankings, private sector comparisons, or even importing best practices from others, but rather optimizing a ministry's ability to fulfill its most basic mandate: protecting the citizenry that it serves. When national security fails, governments, populations, and entire ways of life are in jeopardy.

Based on the increasingly complex global security environment and the re-emergence of long-term, strategic competition among nations, the defense innovation readiness gap represents an existential challenge for ministries of defense. BCG research has uncovered 11 dimensions that provide a proven framework to enable ministry efforts toward

this end. Once a defense innovation model is deliberately selected, MoDs can put in place specific policy actions that can help close the defense innovation readiness gap. Future surveys will be conducted annually to help MoDs track their progress in doing so.

MoDs must mobilize now to meet these challenges; the current pace of defense innovation no longer affords the time for long-term study or nebulous working groups. It will require nothing short of direct and inspired leadership from ministers and secretaries of defense to organize their ministries to meet this moment, close their innovation readiness gap, and position themselves to fight and win in the age of 21st-century conflict. Many are counting on them to achieve nothing less.

Appendix: Survey Methodology

These recommendations were developed from the results of an in-depth survey and analysis of 59 ministries of defense, with participating countries on every continent except Antarctica. The defense activity of the European Union and NATO were also analyzed in this context.

Survey respondents included senior ministry leaders, members of innovation units, and representatives of user and operator groups, testing groups, and acquisition communities within the ministries. We asked respondents to assess their ministry's readiness to innovate, by filling out a BCG benchmarking instrument, the Innovation-to-Impact Readiness Assessment. It consists of about 40 questions that illuminate aspects of the 11 dimensions of innovation readiness. In total, these 11 dimensions describe two broad categories of each ministry's approach to defense innovation: 1) elements of the innovation system (i.e., how a ministry is organized and governed to support innovation at scale); and 2) innovation practices (i.e., the daily work of navigating processes and systems within the ministry to achieve innovation outputs). (See Exhibit 1.)

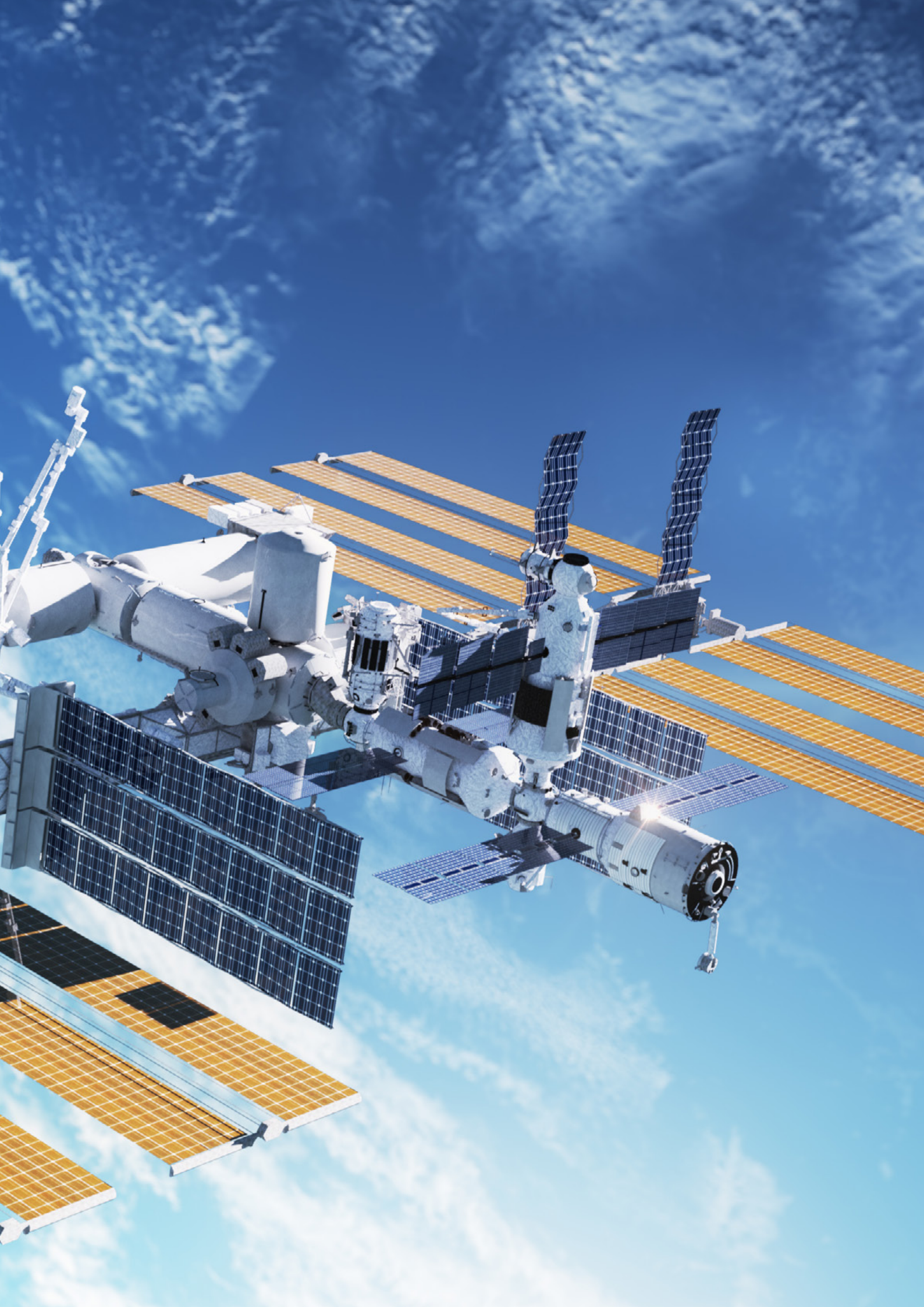
Analysis of these responses conveyed the progress of each ministry along the overall path of innovation

readiness. We averaged those results to develop our view of the overall readiness of ministries in aggregate, and the size of the innovation gap.

We then compared the defense results to private sector benchmarks, to see how far behind (or ahead of) the private sector the MoDs were. These benchmarks, gathered across 19 industries representing 2,249 private sector respondents this year, have been part of BCG's "most innovative companies" research for more than 15 years.

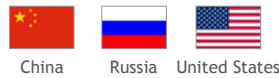
We next looked at the implications for innovation strategy. For each of the 61 surveyed organizations, we collected 40 key indicators, and used them to sort the 59 MoDs into five innovation models that BCG researchers have observed and studied. For each ministry of defense, the choice of innovation model was based on a logical regression analysis of 40 key indicators, each with direct relevance to one or more of the strategies. This analysis was augmented with a naïve Bayesian cluster analysis; a K centroids cluster analysis; and an Altman Z-score analysis.

Future studies, using a comparable instrument, will be able to track the continued progress of ministries of defense along the path to innovation readiness.



Model-Specific Recommendations

Creators and Expanders



Creators and Expanders are nations that focus on “big bet” efforts to create new, disruptive capabilities and expand into new technologies.

Comparative advantage: Significant private and public capital.

Action 1 Define your unique role in the global innovation landscape

Recommendation 1A: Select a defense innovation model guided by your nation’s unique, comparative advantages.

Recommendation 1B: Identify disruptive technologies and enablers (including those outside the traditional defense base) and integrate innovations from a variety of sectors.

Action 2 Communicate a clear innovation ambition and align incentives

Recommendation 2A: Ensure that goals are not solely incremental by identifying three to five “big bets” or “moonshots” that involve stretch goals in technological domains. Create a single innovation agency for each big bet with a clear mandate to take calculated risks, experiment, and aim for breakthrough opportunities.

Recommendation 2B: Institute a performance evaluation system that explicitly rewards risk-taking behaviors, including moonshots. This can include accelerated promotions, monetary incentives, choice assignments, and increased autonomy over spending. Give employees who successfully develop technology breakthroughs managerial autonomy over R&D related to those projects.

Action 3 Actively manage your innovation portfolio

Recommendation 3A: Establish and publish outcome-based metrics for all innovation project. Examples include tracking the progress in scaling projects to the field, TCO, and full life cycle assessment.

Recommendation 3B: Balance short-term and long-term needs with a “70-20-10” mix of priorities. In this mix, 70% of the project allocations support incremental improvements in current core technologies; 20% support adjacent technologies or practices that have not yet been developed; and 10% are reserved for “big bets.” Enforce funding allocations through quarterly reviews by the central governing body.

Action 4 Prioritize developing meaningful innovation partnerships

Recommendation 4A: Establish a unifying central governance body that oversees moonshot efforts and distributes funding for all innovation activities.

Recommendation 4B: Collocate academia, startups, industry, and ministry personnel in physical research hubs to drive collaborative outcomes.

Action 5 Deliberately shape the defense innovation market

Recommendation 5A: Establish an innovation accelerator to connect startups working on early-stage disruptive capabilities with MoD employees to explore dual use (i.e., applicable to commercial and MoD market) applicability.

Recommendation 5B: Set a standard that all weapons platforms will have open architecture for components that increase interoperability within and across platforms.



Model-Specific Recommendations

Solution Builders



Solution Builders are nations that base innovation on end user needs and feedback.

Comparative advantage: Superior end user insight.

Action 1 Define your unique role in the global innovation landscape

Recommendation 1A: Select a defense innovation model guided by your nation's unique, comparative advantages.

Recommendation 1B: Incorporate non-traditional defense industry members in user feedback analytic centers to ensure participation and partnership.

Action 2 Communicate a clear innovation ambition and align incentives

Recommendation 2A: Identify five to ten disruptive technologies or practices that will impact end users by gathering input from vendors, end users, and other stakeholders. Explicitly articulate the integration of feedback as a key pillar of the innovation ambition. Divide R&D efforts into tiers, based on complexity, classification, and cost. This will help personnel understand how to prioritize their efforts.

Recommendation 2B: Reward procurement personnel who prioritize end user feedback. Ensure that acquisition and procurement systems achieve positive impact for end users by paying close attention to project execution from conception through completion, not just specifying the outcome.

Action 3 Actively manage your innovation portfolio

Recommendation 3A: Establish a center for research and analytics that uses metrics to orient innovation efforts to end user needs throughout the innovation life cycle. Set up formal processes for gathering and analyzing data and observations

from the field and integrate them into innovation practice. Even very early observations of technology in use should influence ongoing R&D. Use positive impact on the end user (e.g., hours saved or improved availability of training equipment) as key performance indicators.

Recommendation 3B: Set up a strategic innovation fund to capture emerging technologies that will meet user needs at every life-cycle stage. The fund should incorporate end user feedback from analytic centers throughout each stage of prototyping, testing, and evaluation.

Action 4 Prioritize developing meaningful innovation partnerships

Recommendation 4A: Create a central innovation unit as a centrifuge for end user engagement. Set it up to govern a network of military, industry, academia, and venture capital stakeholders. Frequent engagement from top leadership will allow for rapid approval and deployment.

Recommendation 4B: Embed end users in innovation organizations. Set up secondments for ministry technical talent to industry partners. Establish virtual hubs to collocate all innovation stakeholders. Facilitate regular interaction among end users and stakeholders.

Action 5 Deliberately shape the defense innovation market

Recommendation 5A: Co-locate private and public capital during technology demonstrations for end users.

Recommendation 5B: Identify areas of highest need for interoperability through engagement of end users. Create open systems to improve communication between systems in identified areas.



Model-Specific Recommendations

Fast Adopters

Fast Adopters are nations that quickly tailor, improve upon, and scale other's innovation practices.

Comparative advantage: Rapid learning and agility.

Action 1 Define your unique role in the global innovation landscape

Recommendation 1A: Select a defense innovation model guided by your nation's unique, comparative advantages.

Recommendation 1B: Expand adoption of allies' technology and policies from traditional defense industry to all sectors. Re-imagine and re-engineering solutions for defense problems.

Action 2 Communicate a clear innovation ambition and align incentives

Recommendation 2A: Set key innovation goals: adoption of best practices from other nations and investments in the local industrial base. Identify specific technology and practices being developed by allies as opportunities for adoption and expansion.

Recommendation 2B: Recruit and invest in engineers and technical talent to accelerate adoption through reverse engineering.

Action 3 Actively manage your innovation portfolio

Recommendation 3A: Ensure technologies are adapted in a timely manner by emphasizing key performance indicators related to effectiveness and efficiency. Examples include speed of acquisition, improvement upon original practices, and consistency in tailoring technology to immediate needs. Also track metrics related to staff learning and development for adapting and scaling innovation.



Recommendation 3B: Identify specific weapons platforms and systems to convert to domestic arms production. Fund associated R&D through targeted investment to improve innovation capabilities and reduce the number of technological domains.

Action 4 Prioritize developing meaningful innovation partnerships

Recommendation 4A: Categorize R&D requirements into two to four tiers based on need and complexity. This will help coordinate innovation efforts and clarify which should be homegrown versus which should be adopted from allies and partners.

Recommendation 4B: Create a dedicated ministry organization, such as a technology transfer office, to speed adoption of R&D from allies and improve interoperability.

Action 5 Deliberately shape the defense innovation market

Recommendation 5A: Identify and procure technology and capabilities signaled by partners and allies to be disruptive.

Recommendation 5B: Require open systems and architecture in weapons systems and platforms that are converted to domestic arms production after adoption for allies.



Model-Specific Recommendations

Deployers



Deployers are nations that maximize value from other nations via efficient, timely procurement through multilateral and bilateral agreements.

Comparative advantage: Procurement and nation partnership.

Action 1 Define your unique role in the global innovation landscape

Recommendation 1A: Select a defense innovation model guided by your nation's unique, comparative advantages.

Recommendation 1B: Identify the leading domestic industries in your country and create policies that require engagement of those industries in defense innovation efforts.

Action 2 Communicate a clear innovation ambition and align incentives

Recommendation 2A: Instead of focusing on specific technologies, establish overall procurement excellence. Train people so that procurement and deployment of innovative technology happens throughout the organization. Promote the value of frugality and "punching above our weight," and the wisdom of building strong alliances with technologically adept nations.

Recommendation 2B: Hire and integrate non-traditional talent (e.g., entrepreneurs) into procurement agencies to ensure a diverse, multidisciplinary team.

Action 3 Actively manage your innovation portfolio

Recommendation 3A: Evaluate efficiency of procurement by measuring purchasing power, cost effectiveness (ability to maximize budget), capabilities of technology procured, and speed of procurement (which helps keep systems from being outdated).

Recommendation 3B: Set up clear guidelines for when to outsource and procure from the local industrial base versus when to rely on international partnerships.

Action 4 Prioritize developing meaningful innovation partnerships

Recommendation 4A: Establish a central organization to fund individual innovators and small and medium-size enterprises. The organization should also manage and serve as a liaison for procurement efforts. Rebuild faith in institutions through transparent, clear policies for awarding procurement contracts.

Recommendation 4B: If not part of a major partnership such as NATO, seek favored status such as "major non-NATO ally" to increase access to more mature technology.

Action 5 Deliberately shape the defense innovation market

Recommendation 5A: Aggregate demand with allies that share the same needs to gain access to early, disruptive technology.

Recommendation 5B: Focus on cost-effective procurement by engaging in the competitive marketplace for open, modular systems for major weapons platforms.



Model-Specific Recommendations

Specialists



Specialists are nations that develop a specialized focus in key technology domains of comparative advantage.

Comparative advantage: Superior insight into a few domains.

Action 1 Define your unique role in the global innovation landscape

Recommendation 1A: Select a defense innovation model guided by your nation's unique, comparative advantages.

Recommendation 1B: Create open innovation architectures that allow for free flow of information between industry and the ministry. Review policies and processes related to information classification and compartmentalization.

Action 2 Communicate a clear innovation ambition and align incentives

Recommendation 2A: Assess areas of strength within the venture economy and align R&D domains to one or two high-technology domains. Match strengths with these innovative firms and ensure complementary R&D efforts. State your key ambition as seeking to sustain technological superiority in these areas.

Recommendation 2B: Create a pipeline program with universities to recruit and integrate top student talent into innovation organizations focused on one or two key domains.

Action 3 Actively manage your innovation portfolio

Recommendation 3A: Identify and routinely assess metrics related to industry and ministry leadership in selected domains (e.g., patents granted, or technical publications).

Recommendation 3B: Identify selected domains as core and fund innovation efforts based on the "70-20-10" guidelines to optimize and maintain comparative advantage. Follow market signals from the local venture economy. Deploy smaller, more general R&D investments to ensure harmonization with domestic efforts.

Action 4 Prioritize developing meaningful innovation partnerships

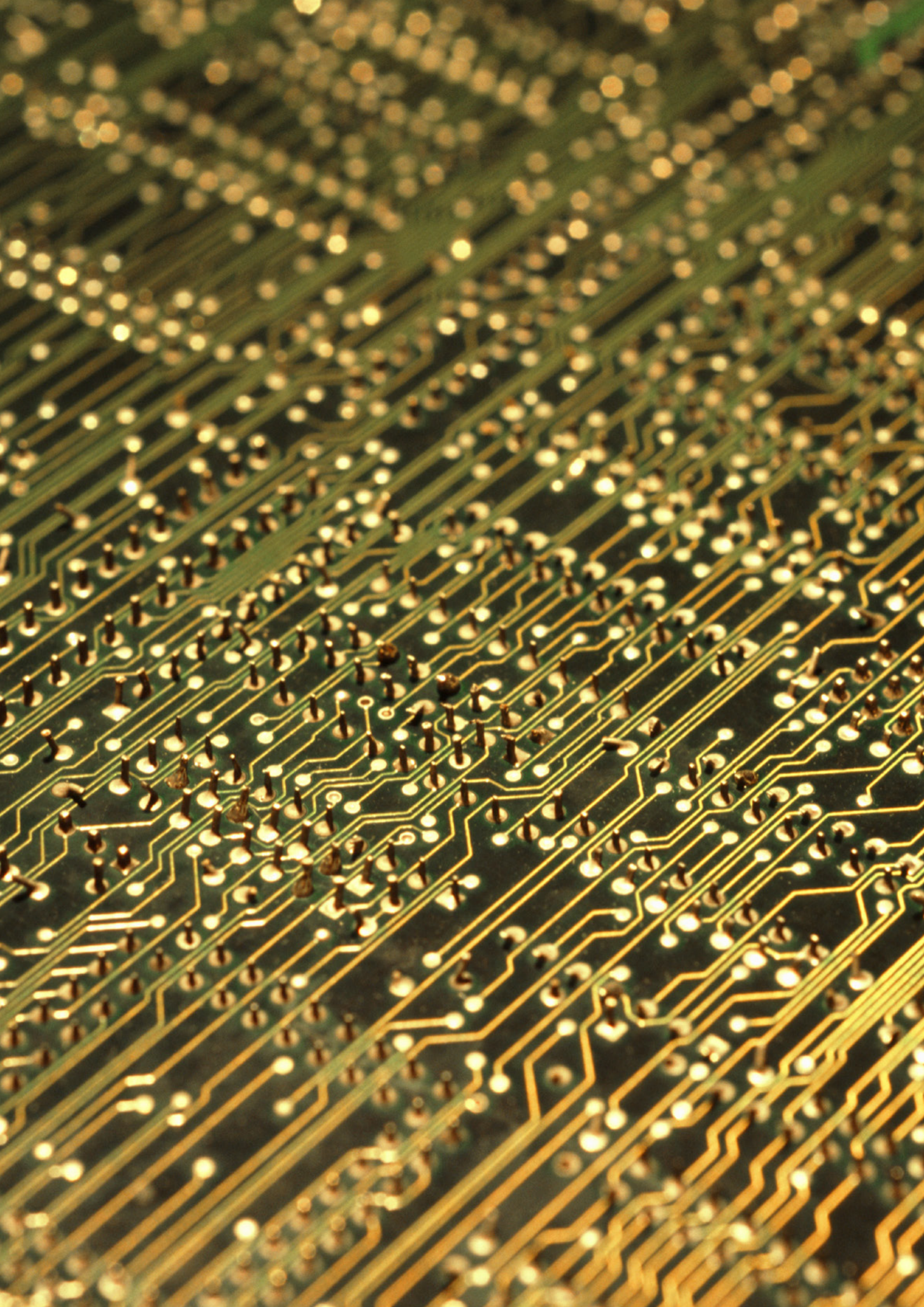
Recommendation 4A: Create a central governance body to oversee the one or two high-priority domains and ensure that ministry needs in other domains are met through additional innovation efforts.

Recommendation 4B: Use formal bilateral partnerships with Creators and Expanders and Solution Builders to access technologies outside of key domains.

Action 5 Deliberately shape the defense innovation market

Recommendation 5A: Monitor and signal interest in emerging technologies in key focus areas early in the product development life cycle to ensure alignment with MoD's needs.

Recommendation 5B: Create a policy of requiring open, modular systems for all new technology and capabilities created in key technology domains.



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