



# National Innovation Strategy: A Proposal From AFCEA International

**19 November 2024**

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An AFCEA International Cyber Committee White Paper

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*PAPER CONTRIBUTORS: AFCEA International appreciates the efforts of the large number of experts who contributed to this report on National Innovation Strategy. AFCEA recognizes that an effort such as this cannot be completed without the professionals who take responsibility for its success and guide it from beginning to end. AFCEA thanks and commends the members and their dedication. Principal author and contributors are recognized in Appendix F: Origins of this AFCEA-Recommended National Innovation Strategy.*

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**"Innovation is the ability to see change as an opportunity—not a threat."**

**— Steve Jobs**

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# 1. Introduction

This National Innovation Strategy (NIS) recommended by AFCEA International is a visionary blueprint designed to position the United States at the forefront of global competitiveness through advanced innovation practices. By fostering cross-sector collaboration, leveraging cutting-edge technologies and implementing novel business models, the NIS aims to address critical challenges and capitalize on emerging opportunities. This strategy underscores the indispensable role of innovation in improving national security, sustaining economic prosperity and advancing societal well-being.

This strategy is the country's vision and long-term goals for innovation. It also provides a roadmap of the strategies to improve innovation governance; deepen and accelerate innovation efforts; and integrate and foster public-private partnerships in the next five years. This initiative was coordinated by AFCEA International's Cyber Committee. AFCEA is a professional association that connects people, ideas and solutions globally in the fields of information technology, communications and electronics for the defense, homeland security and intelligence communities. This strategy is the result of collaborative efforts from diverse members with relevant experience and passion for advancing innovation in the United States. These members exercised their network of contacts throughout government, industry and academia to further review and advise this strategy.



The primary audience for this document is the highest levels of U.S. government. The NIS recommendations and insights in this document may be adopted or modified to support the vision of the incoming administration. The authors created a strategic approach that encourages collaboration across many U.S. stakeholders and allies to foster and maintain a robust and dynamic national innovation ecosystem.

At the heart of any effective strategy is the goal of bridging the gap between current realities and future aspirations. Strategy serves as a navigational tool, guiding the nation through changing conditions and enabling the seizing of opportunities. Without regular updates, strategies risk becoming stagnant doctrines rather than dynamic guides.

This NIS focuses on several critical areas:

- **Collaboration and Partnerships:** Fostering partnerships between government, industry, academia and other stakeholders to share knowledge and resources; engaging appropriately with international stakeholders, including allies and adversaries (See Section 6: Stakeholders, Section 12: International Cooperation for Innovation, Annex 1: U.S. Engagement with the International Innovation Ecosystem and Annex 2: State, Local, Tribal and Territorial Engagement)
- **Policy and Regulation:** Crafting an environment that supports innovation through forward-thinking policies and regulatory frameworks (See Section 7: Policy Framework)
- **Investment in Research and Development (R&D):** Boosting funding for R&D to drive groundbreaking discoveries and technological advancements (See Section 8: Research and Development)
- **Education and Workforce Development:** Enhancing education systems to cultivate a skilled workforce capable of creating, sustaining and advancing innovation (See Section 9: Education and Skill Development)
- **Infrastructure and Technology:** Developing state-of-the-art infrastructure and adopting cutting-edge technologies to support innovative endeavors; enabling innovative practices and methods in addition to technology (See Section 10: Infrastructure and Technology and Appendix D: The State of Emerging Technology)
- **Allocation of Resources:** Optimizing allocation of resources amidst budget constraints and national debt; implementing improved methods and tools for identification and distribution of funding (See Section 11: Funding and Investment and Appendix E: Proposed Federal Innovation Fund)

- **Comprehensive Framework for Monitoring and Evaluation:** Implementing an effective strategy and national innovation ecosystem that can be refined based on clear, measurable expected outcomes; providing transparency and accountability (See Section 13: Monitoring and Evaluation)
- **Sustainable, Inclusive Growth:** Creating an environment where innovation can flourish and organizations can navigate uncertainty, capitalize on opportunities and minimize harmful outcomes (See Section 14: Managing Innovation Risks and Opportunities)

Figure 1-1 shows how implementing this NIS creates and fosters the dynamic innovation ecosystem capabilities that are needed to reach our national goals and objectives. Appendix C: Ecosystem Capabilities provides a deeper look at the capabilities that comprise a robust and dynamic ecosystem.

## Ecosystem Dynamic Capabilities

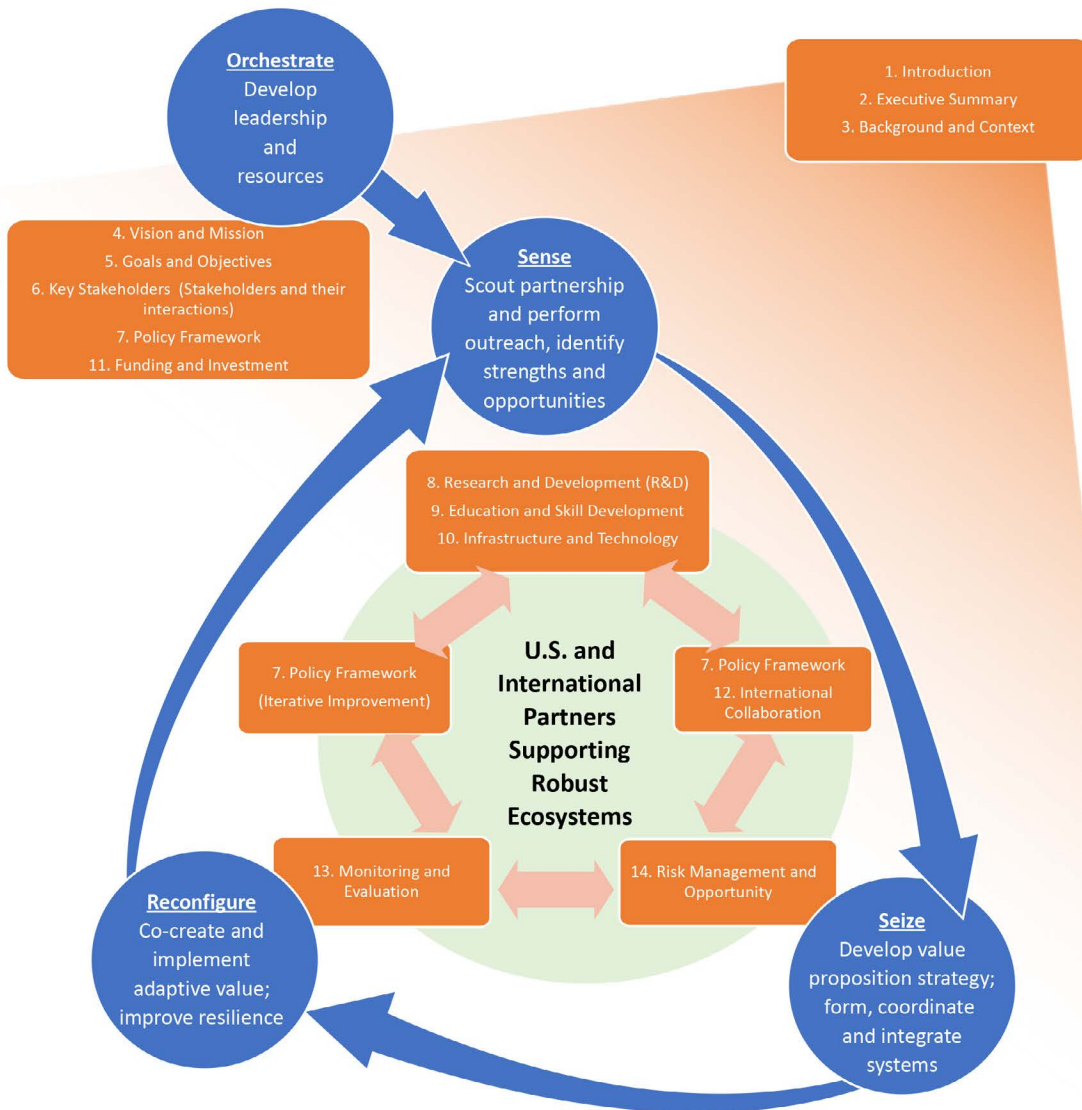


Figure 1-1: Sections of this National Innovation Strategy provide recommendations and information to enable the dynamic capabilities of a national innovation ecosystem.

By addressing these leverage points, the NIS aims to ensure the United States not only remains a leader in innovation but effectively addresses current and future challenges, securing a prosperous and sustainable future for all citizens.

## 2. Executive Summary

This National Innovation Strategy (NIS) recommended by AFCEA International is a blueprint and a call to action. It underscores the pivotal role of innovation in meeting multifaceted challenges and embracing emerging opportunities faced by the United States, from ensuring national security to sustaining economic prosperity and promoting overall societal advancement. Innovation thrives by cultivating a robust and dynamic national innovation ecosystem.

The primary audience for this document is the highest levels of U.S. government. Recommendations and insights may be adopted or modified to support the vision of the incoming administration following the 2024 election. Collaboration of this strategy is expected to be limited to U.S. stakeholders and allies.

The NIS calls upon leaders across government, industry, academia and research to collaborate and foster partnerships to advance U.S. global competitiveness in innovation. This strategy is the result of a small but diverse collaboration of members with relevant experience and passion for advancing innovation in the U.S. Although some agencies and organizations have created reports and strategies, it appears to this AFCEA community that there has not been a national innovation strategy updated or fostered since 2015, nearly 10 years. This strategy offers targeted recommendations for critical components and emphasizes the importance of dynamic and ongoing management.

The United States stands at a pivotal moment in history, where the choices we make will define our global standing for generations to come. Establishing and implementing the NIS over the next five years, through 2030, is urgent for current national priorities and our nation's future. The goals are to rank first in the Global Innovation Index and to continue to advance global leadership in key technology areas; to strengthen the protection and security capabilities of the nation's critical infrastructure, both digital and non-digital infrastructure components, for national security; to increase U.S. economic prosperity in an environment that supports innovation-driven economic growth, job creation, increased productivity and a balance of appropriate regulation and protection of proprietary rights; and to respect individual privacy and civil liberties by balancing technological advancements with ethical considerations.

The critical strategy components include stakeholders, policy frameworks, research and development, education and skill development, infrastructure and technology, as well as funding and investment.

The dynamic management framework includes monitoring and evaluation and risk and opportunity management. Monitoring and evaluation emphasize clear and measurable outcomes, provides transparency and accountability and encourages adaptation to evolving challenges and opportunities. Mechanisms for innovation risk and opportunity management foster sustainable and inclusive growth.

Primary actions to bring this strategy to fruition include:

- 1. Increase Research and Development (R&D) Funding:** Commit to sustained investment in emerging technologies such as artificial intelligence (AI), quantum computing and biotechnology. This investment is crucial for maintaining our competitive edge and driving future growth.
- 2. Strengthen Public-Private Partnerships:** Foster stronger collaborations between government, private industry (from Fortune 500 companies through venture startups) and academia to accelerate innovation and ensure the commercialization of new technologies.
- 3. Develop Agile Regulatory Frameworks:** Create regulatory systems that are adaptable to rapid technological changes, ensuring both safety and the freedom to innovate.
- 4. Establish a National Innovation Council (NIC):** Develop and oversee implementation of the National Innovation Strategy, ensuring alignment with national priorities and effective coordination across agencies.
- 5. Promote Ethical Innovation:** Uphold high ethical standards in the development and deployment of new technologies, ensuring that innovation benefits society.
- 6. Assert Global Leadership:** Actively engage in international partnerships to secure the United States' position as a leader in global innovation; this includes promoting open, collaborative global innovation ecosystems.

When these actions are taken, the United States can advance a culture of learning, critical thinking, innovation and global leadership to secure and sustain core constitutional values of life, liberty and the pursuit of happiness. The National Innovation Council can oversee and coordinate efforts, with specific goals to strengthen national security, foster economic growth, improve supply chains and uphold ethical standards for respecting individual privacy and civil liberties. The resulting resilient and dynamic national innovation ecosystem positions the U.S. to excel in leading future global challenges and opportunities through sustained innovation.

# 3. Background and Context

The security and well-being of the United States are at greater risk today than at any time in recent history. U.S. military superiority, the hard-power backbone of its global influence and national security, has eroded significantly with the national decision to “cash in” on the peace dividend following the collapse of the Soviet Union. Rivals and adversaries are challenging the United States on multiple fronts and in various domains, from cyber to space. The nation’s ability to defend its allies, protect its interests and uphold international norms is increasingly in doubt, necessitating prompt and decisive action to remedy these vulnerabilities (DBB Report 2021).

## Global Innovation Ranking

Despite the pressing need for a coordinated national innovation policy, the United States currently lacks a comprehensive system to address these challenges. The overall innovation system has been deteriorating, with the nation slipping from the top rank in the Global Innovation Index to third place as reported by Visual Capitalist (reference Figure 3-1).

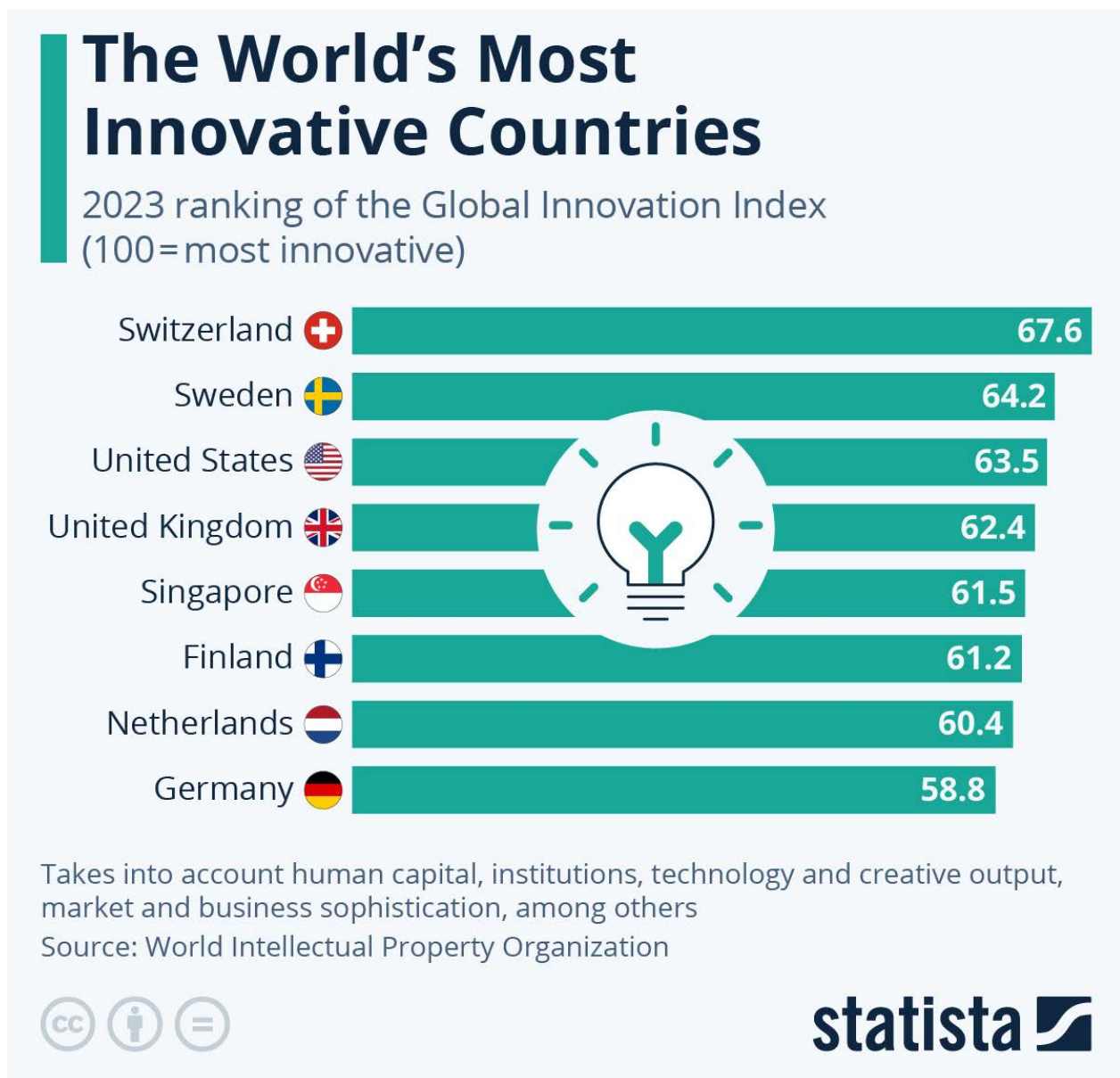


Figure 3-1: Statista reports the United States trails Switzerland and Sweden as analyzed in 80 categories for a composite innovation score. <https://www.statista.com/chart/18804/rankings-of-the-global-innovation-index/>

The economic future and national security of the country hinge on effectively addressing this policy gap. The U.S. national innovation ecosystem is in crisis and requires substantial rejuvenation, particularly through significant increases in federal funding (Atkinson, 2020). A robust national innovation ecosystem necessitates the proper structuring of all three sides of the “innovation success triangle:” the business environment, the regulatory environment and the innovation policy environment (Atkinson, 2020). This NIS addresses these in terms of stakeholders, policy framework and research and development; the NIS identifies additional facets as well, such as education and skill development, infrastructure and technology, funding and investment, and international cooperation. On top of those criteria for a successful structure is ongoing management, including monitoring and evaluation and management, of innovation risks and opportunities. For an advanced economy like the that of the United States, continuous innovation is essential, as our workers and firms are generally operating at the cutting edge of technology.

## External Threats

China’s actions reflect a long-term strategy aimed at achieving global dominance. By diminishing U.S. influence and extending its own economic, political and military reach, Beijing seeks to promote a distinct model of governance—a fusion of strongman autocracy with elements of Western capitalism—as a viable alternative to democratic values and institutions. This includes utilizing its intelligence and influence apparatus to shape international perceptions and gain strategic advantages over competitors, including the United States. (DBB Report 2021). Moreover, the economic landscape is increasingly characterized by volatility, inequality and uncertainty, necessitating a robust response to maintain U.S. economic and technological leadership (Reshi, 2023).

In the face of escalating threats, the United States maintains relatively strong business and regulatory environments. However, the country suffers from a weak innovation policy environment. Compared to other nations, the United States is experiencing a decline in funding for universities, federal labs and other crucial innovation inputs, which policymakers have not adequately prioritized in the federal budget. While no nation has perfected its innovation system, several come close (Atkinson, 2020). The challenge for the United States is whether it can implement the necessary changes to meet the new global competition, especially the strategic alliance between China and Russia.



China’s ascent as a technological powerhouse is not only a threat to U.S. jobs but poses significant concerns for U.S. military capabilities. In critical industries, the competition for technological dominance is one in which the United States is already losing ground. China’s strategy includes leveraging its intelligence and influence networks to shape international views and gain strategic advantages, positioning itself as a formidable competitor to the United States. (DBB Report 2021).

Russia remains an acute and formidable threat to U.S. interests, particularly in Europe. Despite economic challenges, Russia continues to prioritize the rebuilding of its military and uses economic exploitation and provocation to disrupt U.S. influence and restore its global standing. Russia’s actions, including violations of neighboring countries’ borders and efforts to undermine international norms, pose ongoing challenges to U.S. foreign policy and national security (DBB Report 2021).

The United States possesses strengths across all core components of the innovation ecosystem: human capital, intellectual capital, structural capital and reputation capital. However, the global landscape is changing rapidly, and the rules of competition have evolved. Innovation—creating new ideas and translating them into products and services—has become essential for maintaining a competitive edge. The kaleidoscopic effect of compounding trends and global learning demands a new mindset and modern management techniques (Amidon, 2014).

# 4. NIS Vision

Our nation and its allies face an unprecedented period in history that calls for U.S. leadership, innovation and resolve. As the nation confronts a range of emergent and existential threats, it is crucial to harness our spirit of ingenuity through a comprehensive, whole-of-nation approach. These threats challenge the international order and the American way of life, necessitating a unified response to maintain global leadership, national security, economic prosperity and energy independence.

Today, the United States has unparalleled opportunities to support and accelerate advances in research and technology. Innovations in artificial intelligence, quantum computing, synthetic biology, environmental science and other cutting-edge fields offer transformative potential for both national security and commercial markets. These advancements provide opportunities for developing world-class products and services, improving productivity and creating high-paying jobs.

The national innovation ecosystem, composed of diverse networks and partnerships at various levels, is essential for exploring and experimenting with new ideas and concepts. It will leverage the nation's strengths, expertise and collaborative spirit to sustain a decisive edge in global markets.

The vision that drives this NIS and its supporting innovation ecosystem is of a future United States where:

1. **The creative spirit of innovators** energizes our nation to develop innovative products and services that address critical challenges and benefit humanity.
2. **Stakeholders think critically and strategically** to streamline innovation pipelines and expand perspectives.
3. **Society is knowledge-driven**, focused on continuous learning, knowledge creation and collaborative success in competitive markets.
4. **We continuously improve and innovate** to adapt to changing conditions and operate at the forefront of research and practice.
5. **Supply chains and value streams** are continuously examined and improved, including processes, policies, regulations, resources, infrastructure, workforce talent and skills, and markets.
6. **As a "smart nation," we use leading-edge technologies and data-driven strategies** to enhance health, well-being, safety, security, resilience and prosperity.
7. **Critical investments** safeguard national security and competitiveness, addressing both current and future challenges.
8. **Respect for citizens** is demonstrated to empower and engage them to share their diverse abilities and talents in the advancement of innovation.

As a diverse nation with extraordinary talents, the United States has the unique potential to address national and global needs. By developing these capabilities and leveraging synergies, the nation can build a culture of learning, innovation and leadership that secures and sustains the future. This vision aligns with the core constitutional values of life, liberty and the pursuit of happiness. Figure 4-1 describes a fraction of the benefits coming from a culture that embraces this vision.

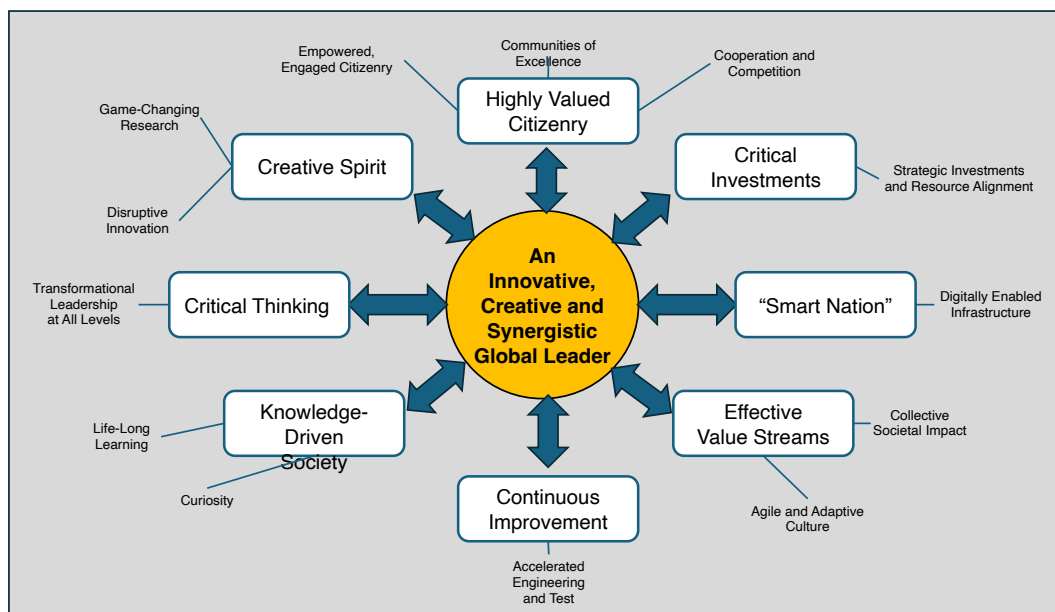


Figure 4-1: National leadership with a vision for a robust innovation ecosystem creates a culture of collaboration leading to national prosperity and global success.

# 5. Goals and Objectives

There are four primary goals for the United States that this NIS seeks to achieve in the next five years following the 2024 election. Development and oversight of the NIS and its implementation will align these national priorities and promote effective coordination of these goals across agencies:

1. **Global Leadership:** Rank first in the Global Innovation Index; continue to advance global leadership in key technology areas, including artificial intelligence, quantum computing and biotechnology.
2. **National Security:** Strengthen the protection and security capabilities of the nation's critical infrastructure, including both digital and nondigital infrastructure components.
3. **Economic Prosperity:** Foster an environment that supports innovation-driven economic growth, job creation, increased productivity and appropriate regulation balanced with protection of proprietary rights.
4. **Privacy and Civil Liberties:** Defend and respect individual privacy and civil liberties, balancing technological advancements with ethical considerations.

Specific, measurable, targeted objectives may be adopted or modified to support the goals and implementation of an established National Innovation Strategy. Potential objectives by category include and are not limited to:

1. **Vision and Goals**
  - Deliver an aspirational statement during the first 90 days of the administration's term to inspire collaborative innovation and shape culture.
2. **Stakeholders**
  - Promote public-private partnerships for working relationships between academia, industry and government entities to create shared knowledge on threats, vulnerabilities, opportunities and resources.
3. **Policy Framework**
  - Establish a National Innovation Council as a high-level body chaired by the director of the Office of Science and Technology Policy (OSTP), responsible for developing and overseeing the implementation of the NIS, aligning national priorities and effective coordination across agencies, including senior designees from key government agencies alongside industry leaders, academic experts and state and local government representatives.
4. **Research and Development**
  - Employ innovation hubs (similar to the University Affiliated Research Centers (UARC) for the U.S. Department of Defense (DoD)) to support research institutions and to support small businesses in key areas with funding and collaboration.
5. **Education and Skill Development**
  - Provide the public with security awareness information and how to mitigate the security risks of emerging technology. This can be achieved through a variety of media and methods.
  - Develop education and training programs to create a workforce knowledgeable in how to incorporate innovative practices and technology in their day-to-day jobs.
6. **Infrastructure and Technology**
  - Develop ethical frameworks to guide responsible technology use.
  - Achieve a secure environment for critical services that incorporates innovative best practices and technology by 2028.
7. **Funding and Investment**
  - Increase funding and incentives for innovation to advance cybersecurity areas such as quantum resistant cryptography, artificial intelligence and blockchain.
8. **International Cooperation**
  - Identify lessons learned from successful international collaborations that exemplify mutual benefit and reciprocity; use these lessons to inform policy frameworks.
9. **Monitoring and Evaluation**
  - Minimize or eliminate unnecessary burdens related to reporting cyber incidents while setting standards for reporting of metrics that focus on creating a resilient and innovative critical infrastructure (best practices, innovative technologies and defense mechanisms).
10. **Managing Innovation Risk and Opportunity**
  - Establish funding guidelines for federal investment in R&D that eliminate biases or barriers to ensure innovation opportunities are not sidelined due to inaccurate perception of risk or value.

# 6. Stakeholders

This NIS emphasizes the importance of a collaborative and inclusive innovation ecosystem, involving a diverse range of stakeholders who can effectively channel enthusiasm, unity of purpose, resources and efforts. It calls for an innovative model of stakeholder relationships, emphasizing the need for clear communication of vision and goals. It seeks public involvement, particularly from citizens and community groups, government, investors, legislators, educators and the R&D communities.

Key stakeholders include:

## 1. Government Agencies:

- **Federal:** Establish a National Innovation Council for oversight and management of the National Innovation Strategy. Set overarching national policies, regulations and funding priorities. Determine how resources are allocated and provide guidelines to shape the direction of innovation in key sectors like health care technology and defense. Key agencies include the DoD, Department of Energy, National Institutes of Health, Department of Homeland Security, etc.
- **State and Local:** Shape innovation-friendly policies and funding environments. Leverage digital platforms to facilitate engagement and civic education. Includes: health and human services, public safety, transportation, utilities, information technology (IT) departments, economic development, planning and zoning, engineering, and building and construction departments.

## 2. Private Sector:

- **Technology Companies:** Collaborate with major technology firms like Google, Apple, Microsoft and Amazon.
- **Small Businesses/Startups:** Involve smaller entities for broad impact, as small businesses account for more than 90% of the IT security/technology sector.
- **Other:** Include middle-tier businesses; incentivize government contractors.

## 3. Research Organizations:

- **Universities and Research Centers:** Generate new knowledge, and advance technology.
- **Federally Funded Research Laboratories:** Mature innovations from basic research to practical, real-world applications.

## 4. Workforce Training:

- **Education/Training Providers:** Enhance science, technology, engineering and math (STEM) training to prepare the future workforce for emerging technological challenges. Follow national education standards. Tailor the approach appropriately for the level of education. Includes: providers at elementary, high school and university levels.
- **State and Local Governments:** Manage and coordinate workforce development programs specific to the needs of regional economies.

## 5. Investors:

- **Key Funding Entities:** Support innovation projects and promising technologies. Consider high-risk, high-reward areas to stimulate innovation.

## 6. Public Involvement:

- **Citizens and Community Groups:** Contribute funds, time and effort. Raise awareness through storytelling and crowdfunding. Acknowledge and celebrate contributions.
- **Professional, Technical or Engineering Associations:** Engage with government, industry and academia to provide specialized expertise, insights and recommendations.

## 7. Legislators:

- **Policymakers:** Shape innovation-friendly policies and funding environments. Foster domestic and international collaboration balanced with national security. Protect intellectual property.

## Classical Case Study

Henry Ford's entry into the automotive industry is a study in how leveraging various stakeholders can lead to groundbreaking innovation. Ford's success at the turn of the 20th century was more than engineering and business acumen; it was also about how different stakeholders engaged to support his vision for a car that the average U.S. worker could afford, making the Model T a cultural icon, symbolizing the democratization of technology and the possibility of upward mobility for the average citizen.

- **Government:** Fostered development of roads, gas stations and related industries.
- **Private Sector:** Paid the unprecedented wage of \$5 per day; created an assembly line.
- **Workforce Training:** Optimized contributions of every worker and skilled knowledgeable workforce.
- **Investors:** Realized potential in Ford's innovative approach.
- **Public Involvement:** Adopted the use of cars in daily life. Established a new class of consumers and workers.

His story exemplifies aligning business goals with the needs and contributions of stakeholders. It shows how stakeholder engagement, when effectively harnessed, can drive significant innovation and create widespread value.

A unified approach involving these stakeholders is critical for driving economic growth, addressing global challenges and enhancing national security. The strategy calls for innovative models of stakeholder relationships, emphasizing the need for clear communication of vision and goals, offering incentives for participation and fostering a culture of innovation across all sectors.

# 7. Policy Framework

The policy framework for the National Innovation Strategy focuses on establishing a conducive environment for innovation through supportive regulations and policies. This initiative involves the following key components:

## 1. National Innovation Council (NIC)

- A high-level body chaired by the director of the OSTP, including senior designees from key government agencies, such as the Department of Commerce, Department of Energy, DoD, National Institutes of Health and executive offices, alongside industry leaders, academic experts and state and local government representatives.
- The NIC is responsible for developing and overseeing the implementation of the NIS, ensuring alignment with national priorities and effective coordination across agencies.

## 2. Policy Development and Prioritization

- The NIC will conduct comprehensive reviews of agency innovation policies to identify regulatory and policy barriers to innovation.
- It will develop specific policy recommendations aimed at promoting technology transfer, protecting intellectual property and supporting workforce development.
- Public-private partnerships will be emphasized to leverage private sector resources and expertise in driving innovation.

## 3. Interagency Coordination

- Agencies will coordinate through the NIC to align their efforts and share best practices, ensuring consistent and mutually reinforcing innovation policies; this includes public consultations to gather input from industry, academia and the public, and legislative collaboration to develop and pass supportive legislation.

## 4. Continuous Evaluation

- The NIC and agencies continuously evaluate and refine policies based on stakeholder feedback and the outcomes of implemented initiatives.
- This adaptive approach ensures that policies remain relevant and effective in a rapidly changing innovation environment.

## 5. Private Sector Engagement

- The federal government will actively engage the private sector through advisory boards, public consultations and working groups, ensuring that private sector insights are integrated into policy formation.
- All collaborations will adhere to legal and ethical guidelines, ensuring transparency and public trust.

## 6. Removing Barriers and Facilitating Private Sector Collaboration

- Efforts will include simplifying application processes for federal grants and contracts, providing tax credits and funding opportunities to encourage private sector investment in research and development (R&D) and enhancing communication channels between government agencies and the private sector.

Through this comprehensive approach, the federal government aims to create a supportive policy and regulatory environment that foster innovation, encourage public-private partnerships and position the United States as a global leader in technology and innovation.

# 8. Research and Development (R&D)

Research and development are the bedrock of the national innovation ecosystem. Our nation's ingenuity has historically led to groundbreaking advancements that solve global challenges and meet consumer needs. From early inventions like electricity to modern developments such as transistors and genome sequencing, U.S. contributions have driven global progress.

The United States is a critical player in global research networks, exploring new frontiers and collaborating with international partners. This collaboration spans a wide range of sciences, from health care and energy to education and training, driving societal improvements.

Research is inherently about knowledge and understanding. It is about exploring the unknown, testing new hypotheses and developing new theories that can significantly affect daily life and society. It helps us rethink our world, advancing our understanding of the universe, society and technology. The R&D continuum includes initial stages of discovery and hypothesis testing and the later stages of iterative engineering and testing processes that establish a foundation for new products and services. These innovations, once scaled, meet market demands and drive economic growth. The continuous evolution of research provides the intellectual feedstock for creating new products and services, which are crucial for economic vitality and global competitiveness. Figure 8-1 describes many steps and stages in the continuous evolution of research.

The continuum of research and development provides the pathways for product and service development and delivery. R&D is a system that operationalizes and creates new paradigms and then delivers them to users to improve the quality of life. Today, we see the transformations resulting from this continuum as innovations in sustainable electrification, communications, health care, transportation, agriculture/aquaculture and energy production. In military and national security, advancements enhance the nation's defensive capabilities against emerging threats.

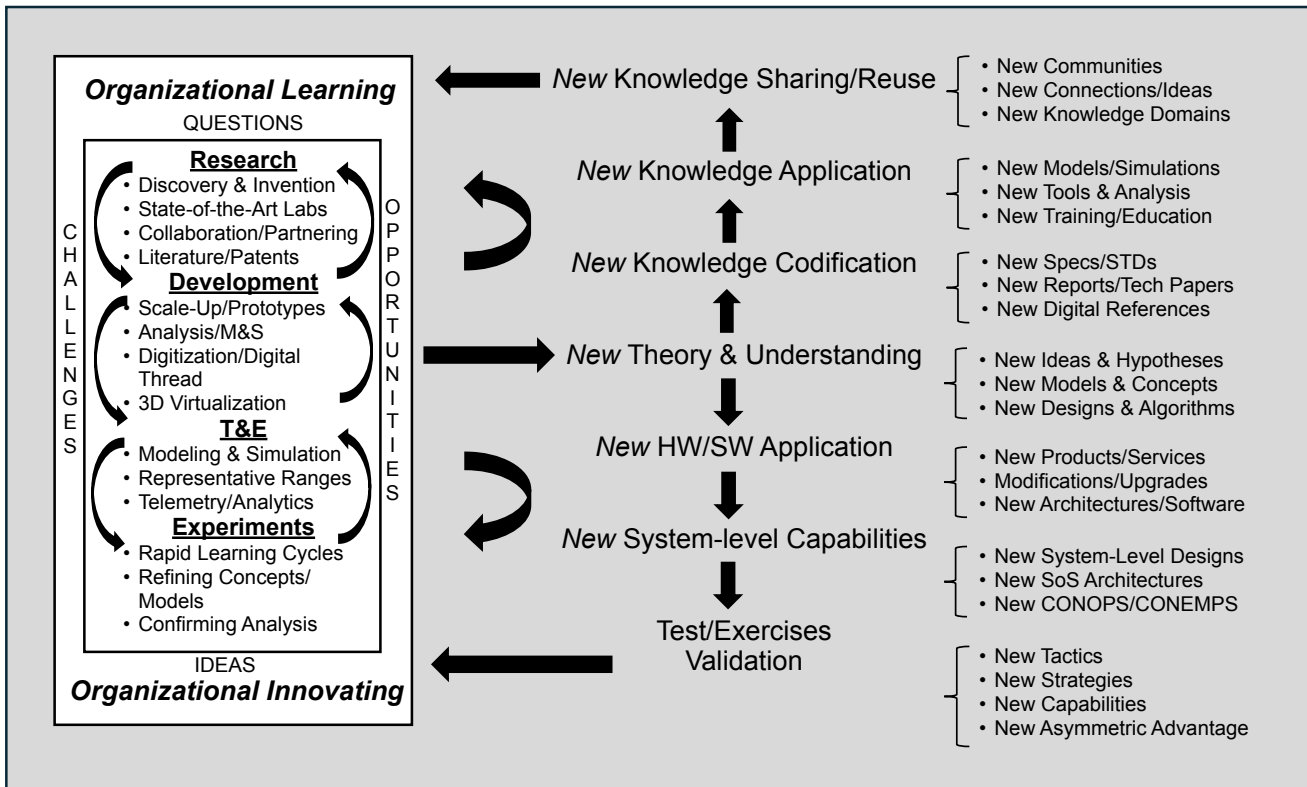


Figure 8-1: Research and development are accelerators for technology advancement and knowledge expansion.

Looking ahead, the potential for further research and innovation is boundless. The acceleration of technological advancements, often exceeding Moore's Law, opens new paradigms and transformative possibilities. The synergy of these advanced technologies, rooted in robust R&D, can disrupt traditional models and create significant societal impacts.

To sustain its economic and security advantages, the United States must maintain a vibrant, dynamic and interconnected R&D ecosystem. This involves leveraging global knowledge, adapting to new information and continuously accelerating the development of new products and services. Supporting educators, researchers and developers is critical for expanding awareness, fostering innovation and maintaining global leadership.

In the face of global competitors and challenges, the United States must remain focused on its core values and vision, striving for economic prosperity and security. Leading the global society through R&D, the nation must drive advancements in theory and practice, promoting the proliferation of knowledge that will guide future success. This requires focused investments in R&D communities, supporting expansive innovation ecosystem and supply chains.

# 9. Education and Skill Development

In today's complex and dynamic environment, leaders must be flexible, adaptable and innovative. Educational institutions play a crucial role in building leaders by providing technical acumen in current technologies (e.g., artificial intelligence and machine learning, cloud, data, cyberspace) and fostering innovative skills. The following methods have proven effective for developing future leaders:

- 1. Student-Centered Learning:** Shift the focus from traditional teacher-centered approaches to student-centered learning. Recognize and accommodate diverse learning styles and preferences and encourage inquiry-based learning and problem-solving.
- 2. Critical Pedagogy:** Encourage a critical examination of societal norms, structures and power dynamics within the educational system. Empower students to think critically about the world around them and become agents of change, fostering dialogue and inclusivity to address social justice issues.
- 3. Lifelong Learning:** Emphasize the importance of continuous learning beyond formal education. Promote a growth mindset that values the process of learning and adapting and encourages the development of skills that are relevant in an ever-changing world.
- 4. Technology Integration:** Recognize the role of technology as a tool for enhancing learning experiences. Embrace digital literacy, and prepare students for a technology-driven future, exploring innovative teaching methods enabled by technology, such as blended learning and online resources.
- 5. Collaborative and Interdisciplinary Approaches:** Encourage collaboration among students, teachers and across disciplines. Break down silos between subjects to promote interdisciplinary learning, fostering teamwork and communication skills necessary for the modern workforce.
- 6. Cultural Competence:** Acknowledge and appreciate diverse cultural backgrounds in the learning environment. Integrate global perspectives into the curriculum, fostering cultural competence and understanding among students and educators.
- 7. Inquiry-Based and Project-Based Learning:** Promote hands-on, experiential learning opportunities. Emphasize problem-based and project-based learning approaches, encouraging students to ask questions, explore solutions and apply their knowledge in real-world contexts.
- 8. Assessment for Learning:** Rethink assessment methods to focus on measuring understanding and application rather than memorization. Use formative assessments to provide ongoing feedback for improvement, encouraging self-assessment and reflection as part of the learning process.
- 9. Entrepreneurial Mindset:** Instill an entrepreneurial mindset that encourages creativity, risk-taking and resilience. Support students in developing skills related to innovation, such as critical thinking, creativity and adaptability.
- 10. Flexible Learning Environments:** Design flexible physical and virtual learning spaces that adapt to different teaching and learning styles, embracing agile and adaptive approaches to education.

Educational initiatives like entrepreneurship programs, innovation labs, startup competitions and collaboration with industry and government play a key role in enhancing innovation and entrepreneurship. Examples include programs at Stanford University, Massachusetts Institute of Technology, Harvard University and others that emphasize innovation and technology management. Collaboration through broad, diverse educational ecosystems, including interdisciplinary curricula and cross-institution partnerships, should be recognized as key drivers of innovation.

# 10. Infrastructure and Technology

Technological innovations are foundational to modern industrial evolution, infrastructure maturation and societal advancement. Such innovations have transformed everyday life and facilitated global connectivity and commerce. As the United States navigates complexities of the 21st century, it is imperative to leverage technology to maintain and extend our leadership in innovation. The rapid pace of technological change presents both unprecedented opportunities and real challenges, and therefore necessitates a strategic approach. While the innovation ecosystem must also support other areas (such as process improvements or knowledge sharing), this section focuses on the use of emerging technologies to secure global leadership in innovation.

## Historical Innovations and Industrial Revolutions

Over the past 250 years, technological advancements have driven several industrial revolutions, each fundamentally altering society and the economy (refer to Figure 10-1). From the mechanization of production in industry 1.0 to the digital transformation of industry 3.0, we are now on the brink of industry 4.0, characterized by cyber-physical systems, and industry 5.0, which emphasizes human-machine collaboration. The anticipated industry 6.0 and 7.0 revolutions, potentially powered by natural organic artificial intelligence systems (NOAI-systems), promise further enhancements in automation and connectivity. This evolution underscores the critical need for advancing digital literacy, upskilling to prepare for future technological landscapes and developing ethical frameworks.

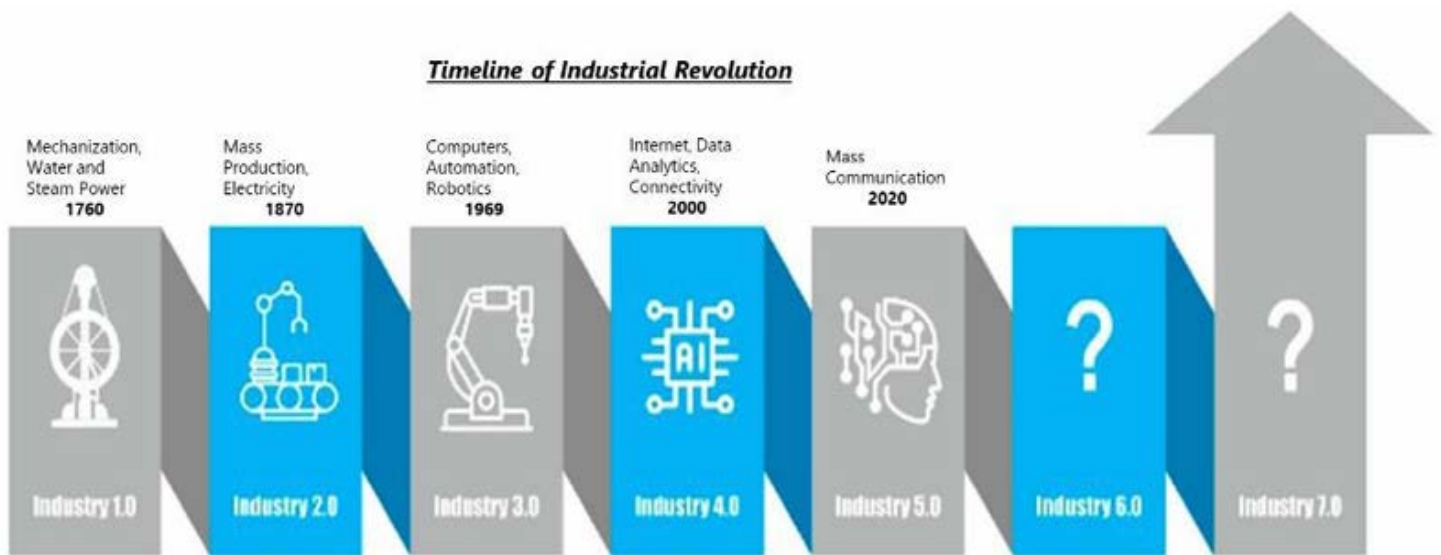


Figure 10-1: Industrial revolutions fundamentally alter society and the economy.

## Digital Infrastructure

A mature digital infrastructure combined with strategic planning for future infrastructure capabilities is necessary to facilitate a national innovation ecosystem. Maturation of historical innovations, such as electricity and the U.S. Interstate Highway System, provided an industrial infrastructure for improved supply chain, manufacturing and distribution. (See Figure 10-2 for additional examples.) We are now at a time in history that requires digital infrastructure to enable advancements in technology, security and prosperity.

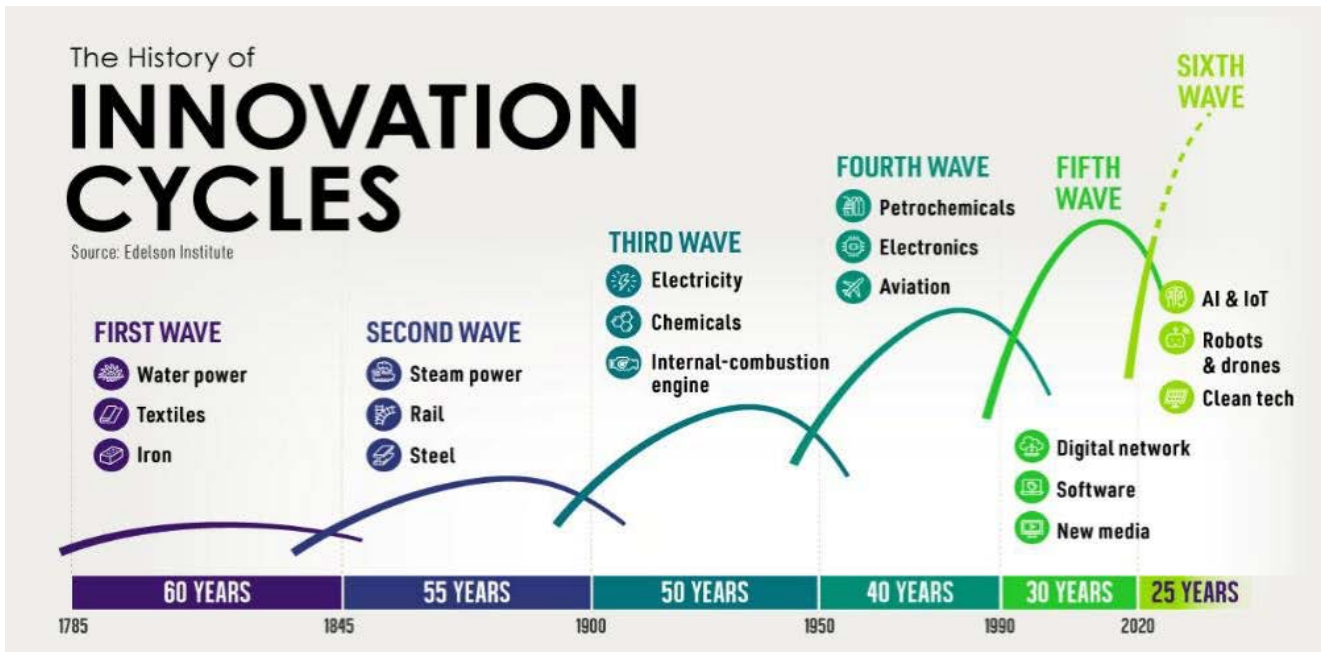


Figure 10-2: Innovation cycles are shortening the lead time for adoption and incorporation into the infrastructure.

Digital infrastructure strategy should consider initiatives that support and enhance both national and international innovation ecosystems such as the following examples:

### 1. Broadband Internet Infrastructure and Broadband for All Initiatives

- **Connect America Fund (CAF):** This Federal Communications Commission (FCC) program aims to expand broadband access for enhanced connectivity in underserved rural areas.
- **Rural Digital Opportunity Fund (RDOF):** This fund allocates billions of dollars for high-speed broadband deployment across rural and remote areas, bridging the digital divide.

### 2. 5G Networks and Deployment of 5G Technology

- **National 5G Strategy:** The United States rapidly is deploying 5G networks to support innovations in sectors such as autonomous vehicles, smart cities and the Internet of Things (IoT).
- **Private Sector:** Companies like Verizon, AT&T and T-Mobile are heavily investing in 5G infrastructure, providing faster and more reliable internet connections.

### 3. Data Centers and Cloud Infrastructure

- **Major Cloud Providers (Amazon Web Services (AWS), Microsoft Azure and Google Cloud):** These platforms offer scalable computing resources, data storage and advanced analytics tools supporting users of all sizes.
- **Government Cloud Initiatives:** Programs like Federal Risk and Authorization Management Program (FedRAMP) promote and standardize secure cloud computing environments for federal agencies.

### 4. Smart Cities and Urban Innovation

- **Smart Cities Council:** This initiative accelerates adoption of smart technologies in urban areas, improving infrastructure, energy efficiency and public services.
- **Local Government Projects:** Cities like New York, San Francisco and Boston are implementing smart technologies for traffic management, public safety and sustainability.

### 5. Research and Development (R&D) Networks

- **Internet2:** A nonprofit, advanced technology community provides high-speed connectivity and collaboration tools for research and education institutions.
- **National Science Foundation (NSF) Networks:** Programs like the NSF's Cyberinfrastructure for Sustained Scientific Innovation (CSSI) provide robust digital infrastructure for scientific research and collaboration.

6. **Cybersecurity Infrastructure and National Cybersecurity Programs**
  - **Cybersecurity and Infrastructure Security Agency (CISA):** CISA works to secure the nation’s critical infrastructure from cyber threats.
  - **Public-Private Partnerships:** Collaborations between government entities and private companies enhance cybersecurity measures and foster a secure ecosystem.
7. **Digital Education Platforms**
  - **edX and Coursera:** Online platforms offer courses from leading universities, making advanced education accessible globally and fostering innovation through knowledge dissemination.
  - **National Education Technology Plan:** This plan promotes the use of technology to transform education.

## Emerging Technologies and Key/Critical Technology Areas

This subsection focuses on a handful of major emerging and critical technologies and technology categories. These examples face hurdles for advancement and adoption, emphasizing the need for a robust supporting innovation ecosystem that includes education, regulation, infrastructure maturation, funding and investment, and other components. Appendix D: The State of Emerging Technology describes the current and future state of these emerging and critical technology areas in more detail.

1. **Artificial Intelligence (AI):** Machine learning, natural language processing and computer vision have led to significant applications such as virtual assistants and autonomous vehicles.
  - Future: Enhanced reasoning, creativity and problem-solving abilities, although achieving artificial general intelligence remains a formidable challenge.
2. **Quantum Computing:** Still in its nascent stages, quantum computing holds the potential to revolutionize fields such as cryptography, materials science and drug discovery.
  - Future: Maturation to overcome error correction and scalability challenges
3. **Blockchain:** Blockchain technology provides decentralized and secure ledger capabilities for applications in cryptocurrency, supply chain management, digital identity verification and secure voting systems.
  - Future: Revolutionize record-keeping, although scalability and regulatory hurdles remain.
4. **Cybersecurity:** Cyber threats make cybersecurity an indispensable focus, with zero-trust architecture gaining prominence, assuming no inherent trust in any user, device or network.
  - Future: Comprehensive overhaul of traditional security models; integration of AI, blockchain and quantum computing to enhance data protection
5. **Secure Supply Chain:** The integrity of global supply chains is increasingly critical as they face risks from disruptions, counterfeiting and cyber threats.
  - Future: Adoption of emerging technologies (blockchain, IoT and AI) to create transparent, secure and efficient supply chain systems, enhance traceability and provide risk management
6. **Biotechnology:** Groundbreaking strides have been made in gene editing, stem cell therapy and personalized medicine. Technologies like CRISPR-Cas9 are paving the way for novel treatments and disease models.
  - Future: Further advancements; revolutionizing health care and bio-manufacturing industries
7. **Advanced Manufacturing:** A high-tech transformation with innovations in 3D printing, advanced robotics and new materials is driving a shift toward smart manufacturing.
  - Future: Interconnected, efficient production systems that are both customizable and environmentally sustainable
8. **Communications and Networking:** Advancements are enhancing data speeds and enabling ubiquitous access to everything and everyone.
  - Future: 6G, quantum communication, expanded satellite networks and new applications like the IoT all contributing to global connectivity and data security

9. **Space Technology:** Space exploration and commercialization are advancing rapidly, with innovations in reusable rockets and satellite constellations.
  - Future: Integration of technologies, including AI and robotics; challenges such as space debris and mission costs persist.

## Technology Risks

As we look toward the future, we see a landscape brimming with technological promise but also fraught with significant challenges. Technology challenges that a national innovation strategy should address include:

8. **Deepfakes:** Sophisticated manipulations of digital content threaten to undermine trust and spread misinformation.
  - **Mitigation:** Develop robust detection methods and accountability mechanisms to safeguard our information integrity.
9. **Misuse of Artificial Intelligence:** AI systems that do not align with human values or that have bias that causes adverse societal impacts
  - **Mitigation:** Monitoring and regulation to ensure AI enhances, rather than disrupts, our way of life
10. **Rapid Pace of Technological Advancement:** Rapid pace can lead to job losses, income inequality and a widening digital divide.
  - **Mitigation:** Investment in education and training programs to prepare our workforce for evolving technological landscape
11. **Integration of Technology Into Our Daily Lives:** Protection of individual privacy in an environment of increased digital footprints; protection against technology addiction
  - **Mitigation:** Develop ethical frameworks to guide responsible technology use.

# 11. Funding and Investment

The NIS emphasizes a balanced approach between fostering innovation and maintaining fiscal responsibility, navigating the complexities of limited discretionary spending and the national debt. It prioritizes strategic funding initiatives such as grants, subsidies and partnerships with the private sector. It supports all phases of innovation, from research and development through adaptation and implementation. The NIS addresses these priorities by proposing strategic allocation of financial investments and by introducing improvements to our methods of funding. The strategy requires:



## 1. **Discovery and Coordination**

- Leverage the federal budget process to conduct systematic analysis of federal innovation investments across various parts of the federal government to identify overlap, eliminate redundancies, enhance collaboration and optimize the use of resources to maximize the impact of federal funding.

## 2. **Evaluation of Effectiveness**

- Evaluate existing innovation programs using robust metrics and performance indicators; assess business cases, ROI and strategic impact on national security and economic competitiveness. Consider that startups, scale-ups and mature firms each have unique needs.
- Direct funding toward initiatives with the highest potential for success, while those not meeting criteria will undergo review for potential rectification or resource reallocation.

## 3. **Creation of an Innovation Investment Fund**

- Bridge the commercialization “valley of death” between laboratory research and widespread implementation.
- This fund provides agile financing to expedite the development and deployment of innovative solutions. Funding technology transfer offices and incubators that bridge the gap between academia and industry are examples of fund use.

#### 4. Catalyst for Private Sector Investments

- Provide strategic deployment of limited federal funds to stimulate private sector investments in high-risk innovation areas with high reward potential.
- Leverage public-private partnerships and incentivize private sector participation, amplifying the impact of government investments and promoting innovation-driven economic growth.

#### 5. Leveraging International Partnerships

- Recognize the value of global innovation networks and leverage international partnerships to access cutting-edge research and enhance the U.S. competitive edge globally. This includes collaborations with international allies and even adversaries, strategically tapping into global innovation investments.

The establishment of specialized task forces composed of seasoned innovators and experts is proposed to recommend priority areas and assess current innovation projects. These task forces will be tasked with the following objectives:

1. **Recommendation of Priority Areas:** Drawing upon their wealth of experience and domain expertise, these task forces will systematically evaluate emerging trends, advancements (e.g., technological, medical, environmental) and societal challenges to identify priority areas with the highest potential for impactful innovation. By convening stakeholders from academia, industry and government, these groups will facilitate interdisciplinary dialogue and consensus-building to crystallize compelling visions for innovation that align with national priorities and strategic objectives.
2. **Assessment of Current Innovation Projects:** In parallel, specialized task forces will be entrusted with the critical responsibility of assessing the efficacy and impact of current innovation projects receiving federal funding. Leveraging rigorous evaluation frameworks and performance metrics, these groups will conduct comprehensive reviews to ascertain the alignment of initiatives with strategic objectives, identify areas for optimization and recommend necessary course corrections or resource reallocation.

Additionally, a Federal Innovation Fund will be established for medium- to high-risk endeavors to de-risk innovation and foster public-private collaboration. This fund will serve as a strategic investment vehicle, providing targeted financial support to innovative projects with significant potential. Key government agencies include the DoD, U.S. Department of Commerce, National Science Foundation and U.S. Department of Energy. Appendix E: Proposed Federal Innovation Fund describes the pivotal roles each agency will play in this framework.

This funding and investment strategy emphasizes the importance of fostering a culture of accountability and evidence-based decision-making. This involves establishing rigorous evaluation frameworks and performance metrics to ensure that innovation investments align with strategic goals and deliver long-term societal and economic benefits.

The sources of funds can be public, private or a mix of the two. Targeted tax incentives and regulatory reforms encourage private sector investment in research and development. By reducing regulatory burdens and streamlining processes, this NIS will create an environment conducive to innovation and entrepreneurship. Collaborative partnerships such as innovation hubs, accelerators and incubators encourage academia, industry and civil society to co-create and implement programs that support innovation and entrepreneurship.

The process for funding innovation is critical. Three areas of improvement in the funding and investment process are: process innovation, technological and digital innovation, and financing mechanisms. Process innovation, such as portfolio management techniques, allows the federal government to strategically allocate resources to high-potential innovation initiatives while ensuring alignment with national priorities and objectives. A past example of government-wide portfolio management is when the executive branch increased tracking and guidance on information technology investments and identification of common services. Technological and digital innovation in financial technologies (Fintech) can democratize access to funding, streamline financial transactions, accelerate access to funding and foster entrepreneurship. Government regulations and oversight of Fintech startups can mitigate risks and ensure stability. Examples of Fintech innovations include microcredits, crowdfunding, digital payments and peer-to-peer lending platforms. Financing mechanisms also benefit from innovation. Innovative use of subsidies, tax incentives, venture capital, angel investment, crowdfunding or debt financing can be used. Hybrid models include public-private partnerships or government-backed investment funds.

Through these comprehensive measures, the United States navigates financial constraints, optimizes resource allocation and maximizes the nation's capacity for innovation, ensuring continued leadership in the global innovation landscape.

# 12. International Cooperation for Innovation

In an increasingly interconnected technological landscape, the United States must lead and nurture international cooperation to address global challenges and leverage diverse expertise. The NIS emphasizes the critical importance of fostering international partnerships to bolster the United States' competitive edge and contribute to global solutions.



## Strategic Importance:

1. **Global Challenges:** Issues such as climate change, pandemics, cybersecurity threats and sustainable development require collaborative solutions. For example, the COVID-19 pandemic underscored the necessity of global cooperation in vaccine research, development and distribution.
2. **Enhancing Competitiveness:** Engaging with international partners allows the United States to access cutting-edge research and integrate global best practices, thus enhancing national competitiveness. Collaborative efforts in fields like artificial intelligence have led to breakthroughs unattainable by any single nation.
3. **Strengthening Alliances:** Innovation partnerships strengthen diplomatic and economic ties, fostering mutual trust and understanding. These alliances are crucial for geopolitical stability and advancing shared goals.
4. **Resource Optimization:** International collaboration optimizes resource use by avoiding duplication, sharing infrastructure and leveraging complementary strengths. Joint initiatives in renewable energy, for example, have accelerated progress in clean technologies.

## Guiding Principles:

1. **Mutual Benefit and Reciprocity:** Collaborations should be based on mutual benefit, ensuring all parties gain from the cooperation. This principle is exemplified by projects like the International Thermonuclear Experimental Reactor (ITER), which relies on equitable sharing of intellectual property and research outcomes.
2. **Transparency and Open Communication:** Clear and transparent communication is essential for building trust and ensuring successful collaborative efforts. This includes regular progress reports and shared platforms for data and knowledge exchange.
3. **Respect for Sovereignty and Diversity:** Acknowledging and respecting diverse cultural, legal and regulatory frameworks is vital. This includes adhering to ethical standards and protecting intellectual property rights.
4. **Inclusive and Equitable Participation:** Efforts should include a diverse range of stakeholders, including developing nations and underrepresented groups, ensuring the broad distribution of innovation benefits.

## Actionable Steps and Unique Considerations:

1. **Bilateral and Multilateral Agreements:** Engage in targeted bilateral agreements with key innovation leaders and participate in multilateral frameworks like Horizon Europe. These agreements should outline shared goals, joint funding mechanisms and collaborative research projects in areas such as quantum computing, biotech and green technologies.
2. **Creating International Innovation Consortia:** Establish thematic consortia focused on areas like climate tech and cybersecurity, involving governments, industry leaders, academic institutions and nonprofits. These consortia should set clear objectives and performance metrics.
3. **Promoting Knowledge Exchange and Mobility:** Develop exchange programs for researchers and students, expanding initiatives like Fulbright and Erasmus+. Create digital platforms for sharing research outputs and best practices, promoting open-access models.
4. **Enhancing Global R&D Funding:** Establish joint funding mechanisms for international R&D projects, including co-investment funds and innovation challenges. Incentivize private sector investment in international collaborations through tax breaks and regulatory support.
5. **Strengthening Intellectual Property (IP) Protections:** Work toward harmonizing IP regulations across borders, collaborating with international bodies like the World Intellectual Property Organization (WIPO). Support developing nations in building IP management capacities.

International cooperation is indispensable for fostering innovation that addresses global challenges and drives societal advancement. By strategically engaging with international partners, the United States can enhance its innovation ecosystem, strengthen global alliances and remain at the forefront of technological leadership. The NIS provides a comprehensive framework for integrating international cooperation into the broader national innovation agenda, ensuring that innovation serves as a catalyst for global progress and prosperity.

# 13. Monitoring and Evaluation

The monitoring and evaluation (M&E) framework is an integral component of this NIS, focusing on setting metrics against goals, defining milestones, measuring progress and building momentum. This comprehensive approach encompasses multiple dimensions, including national security, critical infrastructure, economic prosperity and more.

**Measuring Success:** The NIS will effectively monitor its progress, ensuring alignment with key priorities and driving continuous improvement in fostering innovation. This approach will support sustained economic growth and technological leadership in a rapidly evolving global landscape. To effectively gauge the success, several key metrics will be utilized across critical areas to ensure a comprehensive approach to fostering innovation:

## 1. Policy and Regulation

- **Regulatory Compliance:** Evaluate adherence to standards and best practices, ensuring that regulatory frameworks support innovation and cybersecurity. Track compliance rates and the effectiveness of policy enforcement.
- **Cybersecurity Maturity Assessments:** Conduct assessments to gauge the effectiveness of cybersecurity measures, including risk management and mitigation strategies. Monitor improvements in cybersecurity posture across sectors.
- **Regulatory Innovation Index:** Measure the adaptability and responsiveness of regulatory frameworks to emerging technologies and market changes. Track the number of regulatory updates and new legislation that reduce barriers to innovation.
- **Stakeholder Satisfaction Surveys:** Conduct regular surveys of businesses, startups and researchers to assess satisfaction with the current regulatory environment and identify areas for improvement.
- **Legislative Adaptation Rate:** Measure the speed and frequency at which regulatory frameworks adapt to technological advancements, ensuring that policies remain relevant and supportive of innovation.

## 2. Investment in R&D

- **Ongoing Development in Cybersecurity Ecosystem:** Monitor sustained or increased investments in cybersecurity research and development, focusing on innovation in current environments and the creation of technologies to combat emerging threats.
- **R&D Expenditure Growth:** Track the annual growth rate of investment in research and development across various sectors, comparing public and private contributions. Benchmark against international standards to ensure competitiveness.
- **Innovation Output Metrics:** Measure the number of patents filed, publications and technology transfer activities resulting from increased R&D investments. Assess the commercialization success rate of funded research projects.
- **R&D Collaboration Index:** Evaluate the extent of partnerships between government, industry and academia in R&D activities. Monitor joint projects and co-funding initiatives as indicators of collaborative innovation.

## 3. Education and Workforce Development

- **Workforce Development:** Track the development, growth and skill levels within the cybersecurity workforce. Monitor the number of trained professionals and certifications obtained in cybersecurity and related fields.
- **Awareness and Training Effectiveness:** Assess the depth of awareness and the effectiveness of training programs among relevant stakeholders. Evaluate improvements in cybersecurity knowledge and practices.
- **STEM Education Advancement:** Measure the number of students enrolled in STEM programs and the rate of increase over time. Assess the quality and diversity of educational curricula aligned with industry needs.
- **Professional Development Opportunities:** Monitor the availability and uptake of continuing education and professional development programs for the existing workforce. Assess the impact of these programs on career advancement and innovation capacity.
- **Industry-Education Alignment:** Evaluate the alignment between educational programs and industry needs through employer feedback and job placement rates for graduates.

#### 4. Infrastructure and Technology

- **Direct Cybersecurity Data:**
  - **Cyber Attack Metrics:** Track the number, frequency, severity and variety of cyber attacks with a focus on critical infrastructure.
  - **Response Times:** Measure the speed of detection, identification and response to cyber incidents.
  - **Resource Allocation:** Assess the allocation of resources to cybersecurity, including funding, personnel and hours dedicated to cybersecurity efforts.
- **Infrastructure Readiness Score:** Evaluate the state of physical and digital infrastructure supporting innovation. Measure access to high-speed internet, advanced manufacturing facilities and research labs.
- **Technology Adoption Rate:** Track the rate at which cutting-edge technologies are adopted across industries. Monitor key areas such as artificial intelligence, IoT and biotechnology for signs of growth and integration.
- **Sustainability and Resilience Metrics:** Assess the sustainability and resilience of infrastructure investments, ensuring they support long-term innovation while minimizing environmental impact.
- **Adoption Rates:** Track the adoption rates of new technologies in both public and private sectors, with the Department of Commerce and relevant agencies monitoring and reporting these metrics to the White House OSTP and Congress.
- **Benchmarking Studies:** Assess the quality and performance of innovations through benchmarking studies and performance evaluations conducted by entities like the National Institute of Standards and Technology (NIST).

#### 5. Collaboration and Partnerships

- **Cross-Sector Collaboration:** Measure the extent of collaborative efforts across government (including international partners), academic and industry sectors. Focus on shared initiatives and knowledge exchange to foster innovation.
- **Partnership Impact Assessment:** Evaluate the outcomes of partnerships between government, industry, academia and other stakeholders. Measure the success of joint initiatives in terms of knowledge transfer and innovation output.
- **International Collaboration Index:** Measure the level of engagement with international partners in research and innovation activities. Track participation in global initiatives and cross-border projects.
- **Network Density and Connectivity:** Analyze the extent and strength of networks within the innovation ecosystem. Track the number and diversity of collaborative projects and events that foster knowledge sharing.
- **Interdisciplinary Collaboration Metrics:** Evaluate the extent of interdisciplinary collaborations and their impact on innovation, focusing on the integration of different fields and expertise to address complex challenges.
- **Stakeholder Feedback:** Collect feedback from industry partners, academic institutions and the public facilitated by federal advisory committees like the President's Council of Advisors on Science and Technology (PCAST).
- **Number of International Agreements:** Track the number and scope of bilateral and multilateral agreements established.
- **Funding Levels (International):** Monitor the levels of joint funding for international R&D projects.
- **Research Output:** Measure the number of publications, patents and innovations resulting from international collaborations.
- **Mobility Programs:** Track the number of researchers, students and professionals participating in exchange programs.
- **Diversity and Inclusion:** Assess the participation rates of diverse and underrepresented groups in international innovation initiatives.
- **Impact Assessments:** Conduct regular impact assessments to evaluate the tangible outcomes of collaborative projects on global challenges.

#### 6. Behavioral Outcomes

- **User and Beneficiary Behavior:** Evaluate changes in behavior among users and beneficiaries of innovations, with relevant agencies like the Department of Health and Human Services (HHS) conducting assessments.

#### 7. Economic Impact

- **Economic Contributions:** Analyze the contribution of innovations to GDP growth, job creation and educational advancements, reported by the Department of Labor, Department of Education and Department of Commerce

### Defining Progress Milestones:

1. **Identify Objectives:** Clearly define strategic aims, in terms of technological advancements and economic growth, set by the National Innovation Council (NIC) and reported to the White House and Congress.
2. **Set Key Performance Indicators (KPIs):** Develop KPIs to measure progress toward the defined goals, with the NIC and relevant agencies responsible for this task.
3. **Establish Baseline Data:** Collect and analyze baseline data to understand the starting point, facilitated by the Bureau of Economic Analysis (BEA) and other statistical agencies.
4. **Define Short-Term and Long-Term Goals:** Set specific, measurable, achievable, relevant and time-bound (SMART) goals, establishing clear milestones for both immediate and future achievements.

### Building Momentum:

1. **Strategic Partnerships:** Form partnerships with industry, academia and state and local governments to drive innovation efforts, coordinated by the Department of Commerce and Department of Energy.
2. **Multi-Channel Outreach:** Utilize various communication channels, including social media, professional networks and government websites, to disseminate information and updates, managed by public affairs offices in relevant agencies.
3. **User Engagement Strategies:** Implement strategies to engage users and stakeholders, including incentives for participation and recognition of contributions, facilitated by federal agencies and the NIC.
4. **Capacity Building:** Invest in training and development programs to enhance workforce skills and capabilities, overseen by the Department of Labor and Department of Education.

### Reporting Results:

1. **White House:** Provide regular updates and comprehensive reports to the White House OSTP on the progress and impact of the NIS.
2. **Departments and Agencies:** Share detailed reports and metrics with relevant federal departments and agencies to ensure alignment and coordination of efforts.
3. **Congress:** Submit periodic reports to Congress, highlighting achievements, challenges and future plans.
4. **Public:** Ensure transparent reporting to the public through government websites, press releases and public forums to foster public trust and engagement.

This structured M&E approach ensures that the NIS is effectively implemented, continuously monitored and refined based on clear, measurable outcomes, guaranteeing transparency, accountability and sustained progress in innovation and economic growth.

# 14. Managing Innovation Risks and Opportunities

Innovation inherently involves uncertainty and risk as well as the potential for groundbreaking opportunities. Risk management is crucial to enable organizations to navigate uncertainty, capitalize on opportunities and minimize potential downsides. This is especially important at the national level where the stakes are higher and the impact of success or failure in innovation can be far-reaching. While the aphorism, “The best way to predict the future is to create it” is popular, the role of government should not be to directly control, but rather to set clear guidelines and minimize barriers to innovation. The government’s function is to facilitate innovation by creating an environment where it can flourish while preventing harmful outcomes through oversight and regulation.

Risk and opportunity management is crucial for innovation at the organizational level. Each organization will need to determine applicable categories to manage, which may include: consumer market, financial, operational, technological, regulatory and compliance, environmental, strategic, or reputational risks and opportunities. Components of a good strategy include:

- 1. Balancing Risk and Reward:** Assess existing and potential risks and opportunities. Benefits:
  - Protect and assign resources.
- 2. Creating a Safe Space for Experimentation:** Encourage experimentation and see failure as a learning opportunity rather than a setback. Benefits:
  - Manage and mitigate consequences of failure.
  - Take calculated risks without fear of severe repercussions.
  - Thriving culture of creativity and exploration
- 3. Enhancing Decision-Making and Strategic Planning:** Equip organizations with tools and insights to anticipate obstacles and prepare for scenarios. Benefits:
  - Pivot quickly and adapt strategies in response to emerging challenges or opportunities.
  - Set realistic goals and objectives.
  - Increase the likelihood of successful innovation.
- 4. Ensuring Compliance and Building Trust:** Integrate risk management into the innovation process to ensure compliance with regulations. Benefits:
  - Avoid regulatory breaches, particularly important in sectors with stringent regulations such as health care, finance, technology.
  - Maintain stakeholder trust.

At the national level, the need for a risk management approach to foster innovation is even more critical due to the broader impact of decisions on public welfare, economic stability and national security.

- 1. Managing Systemic Risks:** Identify and mitigate systemic risks that could disrupt large-scale initiatives. Such initiatives resulting from national innovation strategies can have wide-ranging effects on society, the economy and the environment. Initiatives may include developing new technologies, infrastructure projects or policy reforms. Benefits:
  - Ensure that innovation contributes positively to national goals without unintended negative consequences.
- 2. Protecting National Interests and Security:** Safeguard areas of strategic importance that intersect with innovation at the national level. Understand potential vulnerabilities and threats to areas such as defense, cybersecurity and public health. Benefits:
  - Protect sensitive information, infrastructure and resources from exploitation or attack.
- 3. Promoting Sustainable Development and Inclusive Growth:** Ensure that the benefits of innovation are shared broadly across society. Identify potential social, economic and environmental risks associated with innovation. Benefits:
  - Strategies minimize negative impacts and maximize positive outcomes.
  - Ensure that innovation drives progress without exacerbating inequality or causing harm to communities.

4. **Building Public Confidence and Support:** Provide a transparent and effective risk management approach to demonstrate that potential risks are being carefully considered and managed. Benefits:
  - Public support of national innovation initiatives that promote new ideas and technologies (rather than skepticism or resistance due to perceived risks or uncertainties)
  - Greater acceptance and support for innovative policies and projects
5. **Encouraging International Collaboration and Competitiveness:** This allows countries to navigate the complexities of international collaboration, such as intellectual property concerns, trade regulations and geopolitical risks. Benefits:
  - Foster international partnerships, leverage global expertise and enhance competitiveness on the world stage.

Governments prioritize public safety then must minimize risks through stability provided by regulations without stifling the catalytic and disruptive nature of innovation. Overregulation, often justified under the “precautionary principle” of avoiding actions with unknown risks, can stifle innovation. Examples of government stakeholders for risk and opportunity management in the innovation ecosystem include:

1. **New Opportunity Seeking:**
  - **Commerce and National Science Foundation (NSF):** These bodies are responsible for identifying and funding opportunities, supporting R&D through grants and fostering innovation ecosystems.
2. **Regulatory Oversight:**
  - **Agencies like the Federal Aviation Administration (FAA) and Food and Drug Administration (FDA):** They ensure that innovations meet safety and compliance standards without stifling development. For example, the FAA’s evolving regulations on drone technology balance safety with innovation.
3. **Department and Agency Leadership:**
  - Each department and agency is responsible for fostering innovation to improve execution of its mission. Using risk and opportunity management, resources can be assigned appropriately and with agility.

Examples of success and failure in managing risks and opportunities in government investments:

**Success:**

- o **Internet:** Funded initially by the Defense Advanced Research Projects Agency (DARPA), the internet is now a realized opportunity in global technology.
- o **GPS:** From military contracts to widespread opportunity for civilian use.
- o **Human Genome Project:** Major advancements in biotechnology provide opportunities in health care and biotechnology industries.

**Failures:**

- o **Solyndra:** Highlighting the risks of specific company investments
- o **Concorde:** Technological innovation with risk of adoption not translating to commercial viability
- o **Superconducting Super Collider (SSC):** Canceled due to cost overruns

In summary, a risk and opportunity management approach is essential in a robust innovation ecosystem at organizational and national levels. It provides the framework needed to navigate uncertainty, protect resources and ensure that innovation leads to sustainable, inclusive growth. At the national level, this approach is particularly crucial due to the broader implications of innovation on public welfare and safety, economic stability and national security. By managing opportunities, resources can be effectively assigned. By managing risks, organizations and governments can create an environment where innovation efforts can thrive, driving progress and prosperity for all.

# 15. Conclusion

The NIS represents a bold vision for the future of the United States, a blueprint designed to transcend political boundaries and elevate the nation through innovation. This strategy underscores the critical role of executive leadership in shaping our nation's innovative landscape. The strategy recommendations and insights in this document may be adopted or modified to support the vision of the incoming administration. By leveraging strategic tools, such as executive orders, departmental policies and an innovation playbook, we can cultivate a fertile ground for innovation that balances disruptive and catalytic forces. The authors created a strategic approach that encourages collaboration across many stakeholders to foster and maintain a robust and dynamic national innovation ecosystem.



This strategy is more than just a plan; it is a call to action. The United States stands at a pivotal moment in history where the choices we make will define our global standing for generations to come. By embracing a collaborative and dynamic approach, we can navigate the complexities of 21st-century innovation, ensuring national security, technological leadership and economic prosperity. The challenges in discovering and implementing new innovations are significant, but with a clear and concerted effort, we can overcome them.

The need for a robust innovation ecosystem is paramount. This ecosystem will propel the U.S. toward a future characterized by security, leadership and societal advancement. The strategy lays the foundation for a resilient nation capable of thriving in a rapidly changing global landscape. It also emphasizes the importance of clear guidance for international collaboration and protection against adversarial threats.

## Call to Action

It is imperative for the U.S. government, industry leaders, academia and citizens to unite and bring this strategy to fruition. This is not just a governmental task but a national imperative. We must act decisively and with urgency to harness the full potential of U.S. innovation, manage the inherent risks and ensure that the benefits of these advancements are widely shared and felt by all. Actions include:

- 1. Increase R&D Funding:** Commit to sustained investment in emerging technologies such as AI, quantum computing and biotechnology. This investment is crucial for maintaining our competitive edge and driving future growth.
- 2. Strengthen Public-Private Partnerships:** Foster stronger collaborations between government, private industry and academia to accelerate innovation and ensure the commercialization of new technologies.
- 3. Develop Agile Regulatory Frameworks:** Create regulatory systems that are adaptable to rapid technological changes, ensuring both safety and the freedom to innovate.
- 4. Establish a National Innovation Council (NIC):** Develop and oversee implementation of the NIS, ensuring alignment with national priorities and effective coordination across agencies.
- 5. Promote Ethical Innovation:** Uphold high ethical standards in the development and deployment of new technologies, ensuring that innovation benefits society as a whole.
- 6. Assert Global Leadership:** Actively engage in international partnerships to secure the United States' position as a leader in global innovation. This includes promoting open, collaborative global innovation ecosystems.

The urgency to act cannot be overstated. The NIS is a critical initiative that demands our collective effort and unwavering commitment. Together, we can secure a future where the United States not only leads in technological innovation but sets the standard for ethical and responsible advancement in the global community. The time to lead is now. Let us seize this opportunity to build a brighter, more innovative future for all.

# 16. References

- Amidon, D. M. (2007). *The Innovation Superhighway*. Routledge. [com/doi/abs/10.1504/IJPP.2019.103038](https://doi.org/10.1504/IJPP.2019.103038)
- Amidon, D. (2014). *What Kind of Leadership Do YOU Exemplify / Promote?* Presentation at University of Thailand.
- Atkinson, R. (2020). Understanding the US National Innovation System. *Information Technology and Innovation Foundation*.
- Bason, C. (2018). *One: The Innovation Ecosystem*. In *Leading Public Sector Innovation*. Bristol University Press. <https://doi.org/10.51952/9781447336259.ch001>
- Bass, B. M., & Stogdill, R. M. (1990). *Bass & Stogdill's Handbook of Leadership: Theory, Research, and Managerial Applications*. Simon and Schuster.
- Bureau of Labor Statistics. (2015). *Productivity and Costs: Multifactor Productivity Statistics*.
- Defense Business Board. (2021).
- Global Entrepreneurship Monitor. (2022/2023). *Global Report*. Babson College.
- Industrial Revolution: A Transformative Step. (2024, February). MDPI.
- ISO Technical Committee 279. (n.d.). *ISO/DIS 56000: Innovation Management — Fundamentals and Vocabulary under Development*. <https://www.iso.org/standard/84436.html>
- New Green Technology Findings from H. Berkowitz and Co-Researchers Reported (Meta-organizing firms' capabilities for sustainable innovation: A conceptual framework). (2018, February 25). *Journal of Technology & Science*, 381.
- O'Brien, F. A., & Dyson, R. G. (Eds.). (2007). *Supporting Strategy: Frameworks, Methods, and Models*. John Wiley & Sons. <https://www.wiley.com/en-us/content/uploads/2023/02/Building-a-Culture-of-Innovation-in-Government.pdf>
- Partnership for Public Service. (2016, August). *Encouraging and Sustaining Innovation in Government*. <https://ourpublicservice.org/wp-content/uploads/2020/02/Encouraging-and-Sustaining-Innovation-in-Government.pdf>
- Partnership for Public Service. (2023, February 28). *Building a Culture of Innovation in Government*. <https://ourpublicservice.org/wp-220>. <https://www.igi-global.com/chapter/the-integrated-value-model-ivm/285852>
- Reponen, S. (2017). *Government-as-a-Platform: Enabling Participation in a Government Service Innovation Ecosystem*. Aalto University School of Business. <https://urn.fi/URN:NBN:fi:aalto-201703152919>
- Reshi, I. A. (2023). *Unpacking the Complexities of Economic Systems: Exploring Trends, Challenges, and Solutions*. *Journal of Accounting Research, Utility Finance, and Digital Assets*, 1(4). <https://doi.org/10.54443/jaruda.v1i4.60>
- Rinkinen, S., & Harmaakorpi, V. (2019). Business and Innovation Ecosystems: Innovation Policy Implications. *International Journal of Public Policy*, 15(3-4), 299-318. <https://www.inderscienceonline>.
- Schein, E. H. (2010). *Organizational Culture and Leadership* (3rd ed.). Jossey-Bass.
- Smith, S. (2018, July 22). *Fostering Innovation in the Public Sector: An Organizational Innovation Ecosystem Maturity Model*. University of Alberta. <https://era.library.ualberta.ca/items/73254988-2d00-40e9-9bbe-adb04ca2f875/download/1b29649e-7ccb-4fd2-8e73-261e85253aeb>
- Surging Business Formation Research. (2023). *BPEA | FALL 2023*.
- U.S. Environmental Protection Agency. (n.d.). *Federal Technology Transfer Act and Related Legislation*. <https://www.epa.gov/ftta/federal-technology-transfer-act-and-related-legislation>
- U.S. National Academies of Sciences, Engineering, and Medicine. (2022). *Protecting US Technological Advantage*. <https://nap.nationalacademies.org/catalog/26647/protecting-us-technological-advantage>
- U.S. Patent and Trademark Office. (n.d.). *Manual of Patent Examining Procedure: Appendix L - Patent Laws*. <https://www.uspto.gov/web/offices/pac/mpep/mpep-9015-appx-l.html>
- U.S. Public Law 110-69. (n.d.). *America COMPETES Act*. <https://www.govinfo.gov/content/pkg/PLAW-110publ69/html/PLAW-110publ69.htm>
- Visual Capitalist. (2023). *Most Innovative Countries in 2023*. <https://www.visualcapitalist.com/most-innovative-countries-in-2023/>
- Weintraub, P., & McKee, M. (2019, March 1). Leadership for Innovation in Healthcare: An Exploration. *International Journal of Health Policy and Management*. <https://doi.org/10.15171/ijhpm.2018.122>
- White, B., Martin, B., & Wold, R. (2021). The Integrated Value Model (IVM): A Relational Data Model of Business Value. In *Using Strategy Analytics to Measure Corporate Performance and Business Value Creation* (pp. 198- 220). <https://www.igi-global.com/chapter/the-integrated-value-model-ivm/285852>
- World Economic Forum. (2019, October). *Accelerating the Emergence and Development of Innovation Ecosystems through Procurement: A Toolkit*. [https://www3.weforum.org/docs/WEF\\_Innovation\\_Ecosystems\\_Toolkit.pdf](https://www3.weforum.org/docs/WEF_Innovation_Ecosystems_Toolkit.pdf)

# 17. Appendices

## 1. Appendix A: Acronyms

- A comprehensive list of acronyms used throughout the document for ease of reference

## 2. Appendix B: Further Reading

- Additional resources and reading materials for those interested in further exploring topics covered in the strategy

## 3. Appendix C: Ecosystem Capabilities

- A description of what capabilities comprise a robust and dynamic ecosystem

## 4. Appendix D: State of Emerging Technology

- A description to support Section 10: Infrastructure and Technology in more detail of the current and future state of emerging technology and technology categories

## 5. Appendix E: Proposed Federal Innovation Fund

- A description in support of Section 11: Funding and Investment of a Federal Innovation Fund to leverage the federal government's limited capital

## 6. Appendix F: Origins of this National Innovation Strategy

- A brief history of how this document came to be and thanks to the contributors

## Appendix A: Acronyms

AI	artificial intelligence
ARPA	American Rescue Plan Act (Also know as COVID-19 Stimulus Package)
CET	critical and emerging technology(ies)
CHIPS	Creating Helpful Incentives to Produce Semiconductors
CI2	Council for Inclusive Innovation
CIRC	Collaborative Innovation Resource Center
CTE	career and technical education
CTO	Chief Technology Officer
DARPA	Defense Advanced Research Projects Agency
DEIAB	diversity, equity, inclusion, access and belonging
DIU	Defense Innovation Unit
DoD	Department of Defense
EDA	Economic Development Administration
ITER	International Thermonuclear Experimental Reactor NOAi-systems natural organic artificial intelligence systems
NIC	National Innovation Council
NIS	National Innovation Strategy
NSTC	National Science and Technology Council
OSTP	Office of Science and Technology Policy
RF	radio frequency
SBA	Small Business Administration
SBIC	small business investment company
SBIR	small business innovation research
STEM	science, technology, engineering and math
STTR	small business technology transfer
TIP	technology, innovation and partnerships
UARC	University Affiliated Research Centers
USPTO	United States Patent & Trademark Office
VC	venture capital
WTO	World Trade Organization

## Appendix B: Further Reading

15 USC Chapter 63, Technology Innovation. <https://uscode.house.gov/view.xhtml?path=/prelim@title15/chapter63&edition=prelim>

29 USC Chapter 32, Workforce Innovation and Opportunity. <https://uscode.house.gov/view.xhtml?path=/prelim@title29/chapter32&edition=prelim>

42 USC 7675, American innovation and manufacturing. [https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section7675\(a\)&num=0&edition=prelim](https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section7675(a)&num=0&edition=prelim)

Atlantic Council Task Force on US Nuclear Energy Leadership, How to Conquer Obstacles to Innovation and Drive Change, July 2018. <https://ourpublicservice.org/wp-content/uploads/2018/07/6d69c864ccdb70c20e27560ca90ec17a-1531845009.pdf>

Dawson G, Denford J, Desouza K. Governing Innovation in US State Government: An Ecosystem Perspective. The Journal of Strategic Information Systems, Volume 25, Issue 4, December 2016, Pages 299-318. <https://www.sciencedirect.com/science/article/abs/pii/S0963868716301421>

Federal Laboratory Consortium for Technology Transfer, Federal Technology Transfer Legislation and Policy (aka The Green Book), April 2024. <https://federallabs.org/learning-center/t2-toolkit/the-flc-greenbook>

U.S. Patent and Trademark Office, Manual of Patent Examining Procedure, Appendix L: Patent Laws. <https://www.uspto.gov/web/offices/pac/mpep/mpep-9015-appx-l.html>

U.S. Environmental Protection Agency, Federal Technology Transfer Act and Related Legislation. <https://www.epa.gov/ftta/federal-technology-transfer-act-and-related-legislation>

Bason C. One: The Innovation Ecosystem. In Leading Public Sector Innovation, Bristol University Press, June 18, 2018. <https://doi.org/10.51952/9781447336259.ch001>

ISO Technical Committee 279, ISO/DIS 56000: Innovation management — Fundamentals and vocabulary, under development. <https://www.iso.org/standard/84436.html>

Meadows, D. Leverage Points: Places to Intervene in a System. The Donella Meadows Project Academy for Systems Change. <https://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/>

Meadows, D. Thinking in Systems: A Primer. Chelsea Green Publishing, 2008.

O'Brien FA, Dyson RG, editors. Supporting strategy: Frameworks, methods and models. John Wiley & Sons, 2007. <https://www.wiley.com/en-us/Supporting+Strategy%3A+Frameworks%2C+Methods+and+Models-p-9780470728338>

Partnership for Public Service, Building a Culture of Innovation in Government, February 28, 2023. <https://ourpublicservice.org/wp-content/uploads/2023/02/Building-a-Culture-of-Innovation-in-Government.pdf>

Partnership for Public Service, Encouraging and Sustaining Innovation in Government, August 2016. <https://ourpublicservice.org/wp-content/uploads/2020/02/Encouraging-and-Sustaining-Innovation-in-Government.pdf>

Reponen, S. Government-as-a-platform: enabling participation in a government service innovation ecosystem. Aalto University School of Business, Spring 2017. <https://urn.fi/URN:NBN:fi:aalto-201703152919>

Rinkinen S, Harmaakorpi V. Business and innovation ecosystems: innovation policy implications, International Journal of Public Policy, Vol. 15, No. 3-4, October 11, 2019. <https://www.inderscienceonline.com/doi/abs/10.1504/IJPP.2019.103038>

Smith, S. Fostering Innovation in the Public Sector: An Organizational Innovation Ecosystem Maturity Model, University of Alberta, July 22, 2018. <https://era.library.ualberta.ca/items/73254988-2d00-40e9-9bbe-adb04ca2f875/download/1b29649e-7ccb-4fd2-8e73-261e85253aeb>

U.S. Environmental Protection Agency, Federal Technology Transfer Act and Related Legislation. <https://www.epa.gov/ftta/federal-technology-transfer-act-and-related-legislation>

U.S. National Academies of Sciences, Engineering, and Medicine, Protecting US Technological Advantage, 2022. <https://nap.nationalacademies.org/catalog/26647/protecting-us-technological-advantage>

U.S. Patent and Trademark Office, Manual of Patent Examining Procedure, Appendix L: Patent Laws. <https://www.uspto.gov/web/offices/pac/mpep/mpep-9015-appx-l.html>

U.S. Public Law 110-69, America COMPETES Act. <https://www.govinfo.gov/content/pkg/PLAW-110publ69/html/PLAW-110publ69.htm>

Weintraub P, McKee M. Leadership for Innovation in Healthcare: An Exploration, International Journal of Health Policy and Management, March 1, 2019. <https://doi.org/10.15171%2Fijhpm.2018.122>

White B, Martin B and Wold R. The Integrated Value Model (IVM): A Relational Data Model of Business Value. In Using Strategy Analytics to Measure Corporate Performance and Business Value Creation (pp. 198-220), 2021. <https://www.igi-global.com/chapter/the-integrated-value-model-ivm/285852>

World Economic Forum, Accelerating the Emergence and Development of Innovation Ecosystems through Procurement: A Toolkit, October 2019. [https://www3.weforum.org/docs/WEFInnovation\\_Ecosystems\\_Toolkit.pdf](https://www3.weforum.org/docs/WEFInnovation_Ecosystems_Toolkit.pdf)

## Appendix C: Ecosystem Capabilities

The dynamic capabilities (DC) framework has been defined as the organizational and strategic routines to achieve new resource configurations (Eisenhardt & Martin, 2000). Within the context of the innovation ecosystem approaches to management, it could be understood as managers and decision makers in the system developing new capabilities to better match its environments and forces for competitive advantages of innovation ecosystems (Teece, 2018b). The DC framework focuses on how ecosystems can adapt to the multifaceted changes in sociocultural-economic, sociopolitical and socio ecological environments by reconfiguring resources and capabilities to emerge new artifacts.

Dynamic capabilities can be disaggregated into the capacity to sense and shape opportunities and threats, seize opportunities and maintain competitiveness through enhancing, combining, protecting and, when necessary, reconfiguring the [ecosystems'] intangible and tangible assets. The sensing, seizing and reconfiguration capabilities are the underpinning processes and microfoundations of DC that extend beyond the operational routines and capabilities of innovation ecosystems and can include R&D, technology and/or knowledge transfer routines, alliance and acquisition capabilities, and resource allocation routines.

As it relates to developing city and regional sustainable ecosystems and smart cities, in particular, innovation ecosystems link and leverage information technologies (e.g., sensors and connected devices, open data analytics, platforms and fiber-optic networks) with human capital (e.g., universities, companies and public institutions) to foster sustainable innovation for a shared vision of achieving sustainable development goals and products and services with embedded sustainability designed within the emergent commercialized firm. This process requires a high level of resource orchestration and effective leadership. The heterarchical leadership ensures and disseminates the shared goals of the greater ecosystem so that the co-creation of new value propositions can be explored with multiple regional ecosystem actors, organizations and sectors (Linde et al., 2021; Sachs et al., 2019). A critical condition of the shared vision and goal should be oriented around developing products and services designed with embedded sustainability as well as cybersecurity in the engineering and IT innovation sectors. Lastly, the core leadership's governance structure of ecosystem alignment extends the function of forging sustainable partnership configurations. This is where complementary resources, strengths and capabilities are shared and leveraged across partnering organizations and citizens, and benefits and costs are fairly distributed (Berkowitz et al., 2017; Cooperrider & McQuaid, 2012; Laszlo & Cooperrider, 2010; Linde et al., 2021). Since the complementary resources, strengths and capabilities are shared and decision-making contributions are considered interorganizational, resource orchestration capabilities are further developed ecosystem wide.

Resource orchestration within the ecosystem must be integrated throughout the hierarchies of the ecosystem levels to reveal a more comprehensive appreciation of how ecosystem leaders and decision makers can best develop dynamic capabilities to foster sustainable innovation that benefits entrepreneurship teams, investor community, academia, the business ecosystem, the political system and society. This approach offers a remedy to closing the “access to entrepreneurship” gap and increasing the inclusive innovation capacity in regions, cities and towns that have traditionally had limited to no access to innovation programs and platforms, entrepreneurship knowledge, academic institutions and the investment community. One of the greatest challenges of asset orchestration on the scale of the national innovation ecosystem is aligning the necessary resources (mostly knowledge, collaborative innovation workshops, networking and awareness of opportunities for funding and scaling ventures) for value creation “deeply” embedded in the network of local regional communities as well as the emergent mode of entrepreneurship, venturing and commercialization with online/hybrid innovation programs, bootcamps, accelerators and platforms such as the FedTech program.

**Table 3: Literature Synthesis of Ecosystem Innovation and Dynamic Capabilities**

Resource Orchestrating Capabilities of Ecosystem Leadership	Ecosystem Dynamic Capabilities	Description
<u>Orchestrating Capabilities</u>		Enables stakeholders in ecosystems to explore novel business, service, and cultural opportunities; and forge potential ecosystem partners for collaborating and integrating resources. Expanding physical and geographic limits by digitalization advantages
1. Configuring ecosystem partnerships ensures that firm leaders can direct their ecosystems to achieving evolutionary fitness through environmental changes	<u>Sensing</u>	
2. Deploying value propositions ensures the development of new value propositions with multiple ecosystem actors, organizations, and sectors		
3. Governing ecosystem alignment exercises the critical function of finding sustainable partnership configurations where complementary assets are shared and leveraged across firms, and benefits and costs are fairly distributed	<u>Seizing</u>	Stimulates the ability to realize and exploit (cultivate) opportunities through developing public and private commercially attractive value propositions that are also conscious of ecological and social indicators of sustainability-as-flourishing
	<u>Reconfiguring</u>	Ensure that the ecosystem is adaptive and flexible to changing external and internal conditions and with the ability to reorganize its relationship structures and digital offering to better suit changed conditions in the interests of long-term competitiveness and ecosystem evolutionary fitness

Adopted from Clay, 2021

**Table 4: Relating Ecosystem Sustainable Innovation to Meta-Organization Attributes**

<b>Ecosystem Dynamic Capabilities</b>	<b>Meta-organizing attributes</b>	<b>Citation</b>
<u>Orchestration</u> – <i>Formation of ecosystem leadership and ecosystem resources</i>	– Creating workshops and platforms for collaboration	(Adner, 2017; Berkowitz, 2018; Linde et al., 2021)
	– Coordinating and integrating partnerships	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019)
	– Producing norms of ownership, self-regulation, reporting, and oversight mechanisms	(Adner, 2017; Berkowitz, 2018; Ciborra, 1996; Gawer & Cusumano, 2014; Linde et al., 2021)
<u>Sensing</u> – <i>Partnership scouting and outreach, identify strengths and opportunities</i>	– Including a wide range of resource-rich actors and diversity of multiple stakeholders, sectors, formal and informal inclusion, and low-cost structure	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019)
	– Heterarchical planning, strategizing, and co-creation through co-competition, competing institutional logics, and platform dimensions.	(Berkowitz, 2018; Cooperrider & McQuaid, 2012; Linde et al., 2021; Lütjen et al., 2019; Teece, 2018b)
	– Continuous sourcing and forging of potential partnerships	(Berkowitz, 2018; Cooperrider & McQuaid, 2012; Linde et al., 2021; Lütjen et al., 2019)
<u>Seizing</u> – <i>Value proposition strategic development; ecosystem formation, coordination, and integration</i>	– Identify and examine opportunities, collective adaptive learning through multistakeholder conversations, knowledge pooling	(Berkowitz, 2018; Bogers, Chesbrough, Heaton, & Teece, 2019; Cooperrider & McQuaid, 2012; Linde et al., 2021; Lütjen et al., 2019)
	– Collective learning, knowledge transfers, and information pooling for adapting to perturbation by innovative capacities	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019)
	– Cultivating (Exploiting) triple bottom line opportunities, adapting to limitations and trade-offs within the ecosystem through information production, and outreach activities	(Adner, 2017; Berkowitz, 2018; Kapoor & Lee, 2013; Linde et al., 2021; Teece, 2018b)
	– Consensus-based decision making	(Lütjen et al., 2019)
	– Co-development of sustainable value creation strategy	(Lütjen et al., 2019)
<u>Reconfiguration</u> – <i>Adaptive value co-creating and implementing; ecosystem resilience</i>	– Formation of strategic plan and designing value propositions	(Lütjen et al., 2019)
	– Balancing collaborators and competitors to distinguish private and public business modeling and development	(Lütjen et al., 2019)
	– Controlling ecosystem bottlenecking and intermediating entangled logics	(Berkowitz, 2018; Kapoor & Lee, 2013; Laszlo & Cooperrider, 2010; Linde et al., 2021; Teece, 2018a)
	– Anticipatory value proposition co-creation by prospection and wholeness mindset	(Berkowitz, 2018; Laszlo & Cooperrider, 2010; Linde et al., 2021; Lütjen et al., 2019)
	– Being flexible and offering tools to facilitate whole systems change	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019; Teece, 2018b)
	– Building resilience in the ecosystem	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019)
	– Regulatory or institutional change making	(Berkowitz, 2018; Linde et al., 2021; Lütjen et al., 2019; Teece, 2018b)
	– Adaptive and flexible to changing internal (organizations and stakeholders) and external (ecosystem) conditions for evolutionary fitness	

Adopted from Clay, 2021

## Appendix D: The State of Emerging Technology

In this appendix, we highlight some major emerging technologies and technology categories of 2024. These face hurdles for advancement and adoption, emphasizing the need for a robust supporting innovation ecosystem that includes education, regulation, infrastructure maturation, funding and investment, and other components. The <sup>4</sup> [Critical and Emerging Technologies List Update](#) of February 2024 by the National Science and Technology Council (NSTC) of the Executive Office of the President of the U.S. provides a list of 18 critical and emerging technology (CET) areas of importance to national security along with lists of key subfields for each CET. In this appendix, we describe nine key technologies and technology categories and provide an assessment of their current and future states, including:

- Artificial Intelligence (AI)
- Quantum Computing
- Blockchain
- Cybersecurity
- Secure Supply Chain
- Biotechnology
- Advanced Manufacturing
- Communications and Networking
- Space Technology

### **Artificial Intelligence**

In recent years, AI has shown impressive advancements, particularly in fields like machine learning, natural language processing and computer vision. These developments have led to the creation of various applications, ranging from virtual assistants and chatbots to self-driving vehicles and automated medical diagnosis systems. Despite these achievements, AI still operates within narrow domains, excelling at specific tasks but lacking the broad, adaptable intelligence inherent in humans.

Looking ahead, the trajectory suggests that AI will continue to evolve rapidly over the next decade. As computing power increases and algorithms become more refined, AI systems are likely to become more sophisticated and versatile. They may gradually exhibit traits such as human-like reasoning, creativity and problem-solving abilities. However, the pursuit of true artificial general intelligence (AGI), critical and emerging where machines can match or exceed human intelligence across diverse domains, remains a formidable challenge. Whether this milestone will be reached in the next 10 years remains uncertain.

### **Quantum Computing**

Quantum computing is still in the early stages of development, but it's already showing enormous potential for tackling complex computational problems that are beyond the reach of today's classical computers. Leading technology companies such as Google, IBM and Microsoft are at the forefront, pushing to develop more powerful and stable quantum computers by increasing the number of qubits, or quantum bits, these machines can handle.

Despite the excitement, there are significant hurdles to overcome, including issues related to error correction, scalability and creating practical algorithms that can fully utilize the power of quantum computing. Over the next decade, if these challenges can be addressed, quantum computing could transform a variety of fields. For example, it has the potential to revolutionize cryptography, enhance materials science, accelerate drug discovery and refine complex optimization problems.

We might even reach a point of "quantum supremacy," where quantum computers surpass classical computers in performing certain specific tasks. This achievement could lead to groundbreaking advancements in areas such as machine learning, molecular simulations and climate modeling. Moreover, the development of a quantum internet and secure quantum communication networks could dramatically improve data security, paving the way for novel forms of long-distance communication and computing.

## **Blockchain**

Blockchain technology has rapidly become a game-changer in various industries, far beyond its original association with cryptocurrencies such as Bitcoin. Thanks to its decentralized nature and the security of its distributed ledger system, blockchain is paving the way for innovations across multiple sectors. Currently, it is being explored for a range of applications, including supply chain management, digital identity verification, voting systems and management of intellectual property rights. However, challenges such as scalability, energy consumption and regulatory issues are still hurdles that need addressing. Over the next decade, as blockchain technology matures and sees broader adoption, it is expected to revolutionize industries by enabling secure, transparent and tamper-proof methods of recordkeeping.

Smart contracts and decentralized applications (DApps) are poised to automate complex processes, potentially reducing the need for intermediaries and bolstering trust in digital transactions. Furthermore, advancements in technologies like sharding, sidechains and improved interoperability are likely to enhance blockchain's performance and ease of integration. This could lead to more widespread use in various sectors, driving its mainstream acceptance.

## **Cybersecurity**

Cybersecurity has become a critical issue in our increasingly digital and interconnected world, where cyber threats and data breaches pose significant risks to individuals, businesses and governments. As a response to these growing threats, the concept of zero-trust architecture has come to the forefront. This approach moves away from traditional perimeter-based security models and operates under the assumption that no user, device or network should be inherently trusted. Organizations are now embracing zero-trust principles, including continuous verification, least privilege access and microsegmentation, to strengthen their security frameworks.

Implementing zero trust, however, is not without its challenges. It requires a comprehensive overhaul of existing security architectures, making it a complex task for many organizations. Looking ahead to the next decade, as cyber threats continue to evolve and become more sophisticated, the push toward zero-trust architectures is likely to gain momentum. This will be driven by the need for more robust and proactive security measures.

Future advancements in technologies like AI, machine learning and automation are expected to play a key role in streamlining and improving the implementation of zero-trust principles. These technologies could enable more dynamic and adaptive security controls. Additionally, the potential integration of emerging technologies, such as blockchain and quantum computing, into cybersecurity frameworks could significantly enhance data integrity, privacy and resilience against the most advanced cyber threats.

## **Secure Supply Chain**

Securing the integrity of global supply chains is increasingly critical in our interconnected world, where disruptions, counterfeiting and cyber threats can lead to significant consequences. To address these challenges, organizations are currently deploying various measures, including track-and-trace systems, comprehensive risk assessments and enhanced collaboration with partners and regulatory bodies. Despite these efforts, vulnerabilities remain, leaving supply chains exposed to risks such as data breaches, intellectual property theft and physical tampering.

Looking ahead to the next decade, we can anticipate substantial advancements in supply chain security driven by the integration of emerging technologies such as blockchain, the Internet of Things (IoT), AI and advanced analytics. Blockchain, for example, offers a distributed ledger technology that could significantly enhance secure, transparent and immutable recordkeeping, improving traceability and the tracking of provenance throughout the supply chain.

Moreover, IoT sensors and AI-driven monitoring systems could provide real-time visibility into the operations of a supply chain, enabling proactive risk mitigation and more timely responses to potential threats. Further fortification of supply chains could be achieved through the integration of robust cybersecurity measures, including zero-trust architectures and quantum-resistant encryption. These technologies promise to safeguard the confidentiality, integrity and availability of sensitive data and systems, ensuring a more secure and reliable supply chain ecosystem.

## **Biotechnology**

Biotechnology has made incredible advances in recent years, fundamentally transforming sectors such as health care, agriculture and environmental cleanup. We are currently seeing significant breakthroughs in gene editing, stem cell therapy and personalized medicine propelled by technologies like CRISPR-Cas9 and induced pluripotent stem cells (iPSCs). These innovations are laying the groundwork for novel treatments and new models of diseases. Despite these advances, the field faces ongoing challenges such as ethical dilemmas, regulatory barriers and the need for broader clinical trials.

Looking ahead to the next decade, biotechnology is set to progress even further, driven by the fusion of groundbreaking technologies including AI, nanotechnology and bioprinting. We can expect gene therapies and regenerative medicine to become more widely available, providing customized treatments for genetic conditions, cancer and degenerative diseases. Synthetic biology could lead to new ways to engineer organisms, potentially revolutionizing the production of biofuels, biomaterials and pharmaceuticals.

Additionally, the marriage of biotechnology with digital technology, such as wearable health monitors and remote monitoring systems, is likely to usher in more personalized and proactive health care solutions. However, the path forward must carefully navigate issues of biosafety, bioethics and public acceptance to ensure that biotechnological innovations are developed and used responsibly.

## **Advanced Manufacturing**

Advanced manufacturing is all about getting a high-tech makeover and furthering automation. It uses fancy tools and processes to completely transform how we design, build and deliver products. Right now, 3D printing is already changing the game, especially for creating prototypes and products in fields like medicine and airplanes and replacing assembly lines, robots working alongside people and super strong, lightweight materials. Factories are also getting a robotic upgrade with smarter, more helpful robots that can work safely with people to get things done faster and better. But that is not all. Scientists are developing incredible new materials that are strong, light and have all sorts of special functions. These are being used to make all kinds of things better. On top of that, imagine machines talking to each other and sharing information; that is the Internet of Things in action, and it is helping factories run smoothly and efficiently.

So, what is next for this high-tech manufacturing world? Get ready for even more 3D printing, making things customized and eco-friendly. Robots are about to get a major AI boost, becoming even smarter and more flexible. Imagine entire factories that are completely connected and can adjust to changing needs on the fly; that's industry 4.0 in a nutshell. Protecting the environment will also be a big focus, with factories finding ways to use recycled materials and create less waste. Plus, scientists are cooking up even more amazing materials with mind-blowing properties. And with all this new technology, some production might even happen closer to where things are needed, reducing shipping and waste. The future of manufacturing is all about using cutting-edge technology to make things faster, smarter and greener. It is about creating a whole new way of producing things that is adaptable, customized and keeps the environment in mind.

## **Communications and Networking**

The way we communicate and connect with each other has completely transformed in recent years, and the next 10 years are set to be even more mind blowing. Here is a quick look at where we stand today and what exciting things are on the way. Right now, we are seeing a huge boost in mobile data speeds with the rollout of 5G networks. This means things will be faster, there will be less lag; and way more devices can connect at once. Cloud computing is all the rage, giving us access to tons of computing power whenever we need it. There is also a growing trend of "edge computing," which puts the processing power closer to where the data is coming from, which is perfect for things like the Internet of Things where speed is crucial. As a corollary to IoT, there are connected devices everywhere, creating a massive amount of data that needs to be managed and analyzed effectively. Security is a major concern as we rely more and more on digital connections, so new and advanced solutions are constantly being developed to keep us safe. Finally, AI and machine learning are becoming an important part of communication systems, making them smarter, faster and better at spotting problems and helping us make decisions.

But that is just the beginning. The future holds even faster and more powerful connections with 6G and beyond, which will be perfect for things like virtual reality experiences and talking to people as holograms. Quantum communication is on the horizon too, promising unbreakable encryption and lightning-fast data transfer. We will also see more satellites blanketing the Earth, providing better internet access everywhere, even in the most remote places. Imagine being able to monitor far-off areas or respond to disasters with better communication tools. With super low latency networks and advanced sensors, the "tactile internet" will allow for real-time remote surgeries and other incredible experiences. Networks are also going to get a lot

smarter thanks to AI, which will help them manage themselves and allocate resources automatically. And of course, as virtual reality and augmented reality (XR) technologies become more popular, we will need even more powerful networks to handle all those immersive experiences.

The next decade of communication is all about being connected like never before. It will open doors to new applications and services that we cannot even imagine yet. But with all this progress, we also need to think carefully about privacy, security and how this technology will be used ethically. It is an exciting future but one we need to approach with a thoughtful mind.

## Space Technology

Space technology has experienced significant advancements recently, thanks to the collaborative efforts of government space agencies and private sector pioneers. Innovations like the reusable rocket systems developed by SpaceX and Blue Origin have dramatically lowered the costs of space access, facilitating more frequent launches and broadening the scope for space exploration and commercial endeavors. Moreover, the deployment of satellite constellations has transformed fields such as communications, earth monitoring and navigation systems.

Despite these advances, the sector still faces hurdles like space debris, limited launch capacity and the substantial costs associated with deep space missions. Over the next decade, we can anticipate even more rapid progress in space technology. Developments are likely to include more efficient propulsion methods, the use of advanced materials and the miniaturization of electronics. These technologies could make possible the sustained human presence on the moon and even the first manned missions to Mars, supported by advances in in-situ resource utilization, habitat construction and life support systems. Additionally, the integration of cutting-edge technologies such as AI, robotics and additive manufacturing could greatly enhance space operations. These might enable autonomous exploratory missions, self-repairing machinery and the on-site manufacturing of necessary components.

Looking forward, international collaboration, responsible governance and sustainable practices will be essential to safely and fairly exploit space resources and ensure the continued expansion of our capabilities beyond Earth.

## REFERENCES

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- 1 [Global Entrepreneurship Monitor 2022/2023 Global Report](#), Babson College.
- 2 [Surging Business Formation](#), Research BPEA | FALL 2023
- 3 [Industrial Revolution a Transformative Step](#), MDPI, Feb 2024
- 4 [The Critical and Emerging Technologies, White House 2024](#)

## Appendix E: Proposed Federal Innovation Fund

To effectively leverage its limited capital as a catalyst for private sector innovation in medium- to high-risk endeavors, the federal government will establish a Federal Innovation Fund aimed at de-risking innovation and fostering collaboration between public and private entities. This fund will serve as a strategic investment vehicle, providing targeted financial support to innovative projects with significant potential for societal impact and economic growth. Specific roles for key government agencies within this framework include:

### 1. Department of Defense (DoD):

- a. Leveraging its robust research and development capabilities, the DoD will identify and prioritize innovation projects aligned with national security imperatives.
- b. The DoD will contribute expertise in technology assessment and validation, utilizing its test and evaluation infrastructure to de-risk innovations with potential dual-use applications.
- c. Collaborating with defense contractors and startups, the DoD will facilitate technology transfer and commercialization efforts, fostering innovation diffusion across the broader economy.

### 2. Department of Commerce:

- a. Drawing on its industry expertise and market intelligence capabilities, the Department of Commerce will identify emerging market opportunities and high-potential sectors for innovation investment.

- b. Through initiatives like the National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP), the Department of Commerce will provide technical assistance and advisory services to help startups and small businesses navigate regulatory hurdles and scale their innovations.
- c. The Department of Commerce will foster public-private partnerships and matchmaking initiatives, connecting innovators with potential investors, strategic partners and customers to accelerate market entry and commercialization.

### **3. National Science Foundation (NSF):**

- a. Building on its track record of supporting fundamental research and fostering innovation ecosystems, the NSF will identify breakthrough technologies and scientific discoveries with transformative potential.
- b. The NSF will prioritize funding for multidisciplinary research projects that address complex societal challenges and catalyze innovation across sectors.
- c. Through programs such as the Innovation Corps (I-Corps), the NSF will provide entrepreneurial training and mentorship to researchers and innovators, equipping them with the skills and resources necessary to navigate the commercialization pathway and attract private sector investment.

### **4. Department of Energy (DOE):**

- a. Leveraging its expertise in energy research, the DOE will identify and support innovative projects aimed at advancing clean energy technologies, enhancing energy efficiency and reducing carbon emissions.
- b. The DOE will provide funding and technical assistance to accelerate the development and deployment of breakthrough energy innovations, fostering collaboration between research institutions, industry stakeholders and entrepreneurs.
- c. Through initiatives such as the Advanced Research Projects Agency-Energy (ARPA-E), the DOE will support high-risk, high-reward research initiatives that have the potential to transform the energy landscape and drive sustainable economic growth.

By harnessing the complementary strengths of agencies such as the DoD, Department of Commerce, NSF and DOE, the federal government can optimize the impact of its limited capital as a catalyst for private sector innovation. Through strategic coordination and collaboration, the Federal Innovation Fund will stimulate entrepreneurship, drive technological advancement and position the United States as a global leader in innovation and competitiveness.

## **Appendix F: Origins of this AFCEA-Recommended National Innovation Strategy**

This National Innovation Strategy is the culmination of collaborative efforts from a diverse group of individuals and organizations dedicated to advancing innovation in the United States. At the heart of this initiative is the Cyber Committee, a part of AFCEA International. AFCEA International is a professional association that connects people, ideas and solutions globally in the fields of information technology, communications and electronics for the defense, homeland security and intelligence communities. AFCEA's Cyber Committee is comprised of experts from various sectors who provide insights and guidance on cybersecurity and related technological challenges.

In September 2023, James P. Craft Jr., a member of AFCEA's Cyber Committee since 2008, presented the need for a new national innovation strategy. He highlighted that the existing Obama administration's 2015 Strategy for American Innovation had not been fully implemented, creating a gap that needed to be addressed. Mr. Craft identified numerous individuals within the innovation community who were interested in developing a new strategy to present to the administration following the 2024 presidential election with the hope that a strategic approach to fostering the U.S. national innovation ecosystem would begin the day after the inauguration of the president.

The Cyber Committee reviewed the 2015 strategy and saw opportunities for improvement. In response, the members appointed Mr. Craft and Henry J. Costa as co-chairs to lead a collaborative effort to develop this National Innovation Strategy. A group of AFCEA and non-AFCEA members was assembled, holding coordination meetings monthly with additional subgroup meetings as needed.

This collaborative effort resulted in a draft that underwent "pink team" and Cyber Committee reviews in August and September 2024. The strategy presented here represents the work of many individuals acting in their personal capacity and does not

reflect an official position of any organization. While some contributors and reviewers remain anonymous, numerous people participated in many various discussions, providing valuable insights without directly contributing written input to the editing team.

Through this collective endeavor, this National Innovation Strategy aims to chart a course for sustained innovation and technological leadership for the U.S. in the coming years.

We want to thank everyone who has contributed to this effort. It has been a massive undertaking, and we eagerly await how it will contribute to the development of the U.S. national innovation ecosystem.

Individuals recognized for their contributions are as follows in alphabetical order of their last names.

Dr. Larry Clay  
Henry J. Costa, D.Sc.  
James P. Craft Jr.  
Dr. Ethan Lick Eagle  
Dr. Vanessa Farsadaki  
David Ihrie  
Karlton Johnson  
Beth Martin  
Necarsia (Nicky) McKinnon  
Russell Miller  
Dr. Dale Moore  
Kathrine Neves  
Gilberto S. Perez  
Anitha Raj  
Lynne Schneider  
Sandeep Shilawat  
Paul Wertz  
Basil White  
Sherry Yokim

# 18. Annexes

## 1. Annex 1: U.S. Engagement With the International Innovation Ecosystem

- Examination of the global innovation landscape and the U.S. strategic partnerships

## 2. Annex 2: State, Local, Tribal and Territorial (SLTT) Engagement

- Strategies and best practices for engaging SLTT entities in innovation initiatives

## Annex 1: U.S. Engagement With the International Innovation Ecosystem

### Introduction

This annex on U.S. engagement with the international innovation ecosystem is a supporting document for the National Innovation Strategy (NIS) developed by the Cyber Committee of AFCEA International and various innovation practitioners and experts.

This annex covers federal engagement with international and multinational stakeholders, allies and adversaries. Stakeholders include nation-states, corporations and international organizations.

The NIS is a visionary blueprint designed to position the U.S. at the forefront of global competitiveness through advanced innovation practices. By fostering cross-sector collaboration and leveraging cutting-edge technologies and novel business models, the NIS aims to address critical challenges and capitalize on emerging opportunities. This strategy underscores the indispensable role of innovation in securing national security, sustaining economic prosperity and advancing societal well-being.

AFCEA International is a nonprofit organization dedicated to connecting people, ideas and solutions globally. Founded in 1946, AFCEA serves as a hub for professionals in defense, intelligence and security sectors, promoting dialogue and collaboration between government, industry and academia. AFCEA International's Cyber Committee is a specialized group within the organization that focuses on cybersecurity challenges and opportunities. This committee brings together experts to share insights, develop solutions and promote best practices in cybersecurity. Through initiatives like the National Innovation Strategy, the Cyber Committee aims to enhance the nation's resilience against cyber threats and drive forward-thinking approaches to innovation in the digital age.

### U.S. Engagement With the International Innovation Ecosystem

U.S. engagement with the international innovation ecosystem as an annex to the National Innovation Strategy (NIS) provides a comprehensive strategic framework for guiding the federal government in its strategic interactions with various global entities. These include allied nations, neutral states, nongovernmental organizations (NGOs), global corporations, adversary nations and transnational criminal organizations. This annex provides a high-level analysis of key international players in innovation, assessing their strengths, weaknesses, opportunities and threats (SWOT). Furthermore, it outlines strategic recommendations for improving U.S. engagements with these multinational organizations and nations to foster a robust, cooperative and forward-looking global innovation network.

The U.S. must strategically engage with international innovation leaders to maintain its competitive edge and address global challenges. By leveraging the strengths of these nations, addressing their weaknesses and capitalizing on opportunities, the U.S. can foster a collaborative and innovative global ecosystem. These engagements will not only bolster economic growth and national security but also contribute to global stability and sustainable development.

The overarching goal is to leverage international innovation to bolster the United States' technological and economic leadership while safeguarding national security and intellectual property.

The purpose of this annex is fourfold:

1. **Guide Federal Engagement:** It aims to steer the federal government's engagement with a broad spectrum of international actors, ensuring coordinated and effective interactions that advance U.S. interests.
2. **Leverage Global Innovation:** The annex seeks to harness the innovative work conducted by global organizations, integrating their advancements into U.S. initiatives to enhance technological progress and economic growth.
3. **Apply Innovative Solutions:** By incorporating international innovations, the U.S. can develop and implement advanced solutions to address global challenges and improve its global engagements.
4. **Protect U.S. Interests:** A critical component of the annex is to protect U.S. intellectual property and competitive advantages from theft, sabotage and other threats posed by adversarial entities.

### Benefits of a Synchronized International Engagement

Engaging with the international innovation ecosystem in a synchronized manner offers numerous benefits:

1. **Efficiency and Effectiveness:** Coordinated efforts across various international platforms reduce redundancy and streamline resource utilization, thereby enhancing the overall effectiveness of U.S. initiatives.
2. **Cost Savings:** By leveraging existing global research and development, the U.S. can save significant amounts of money, avoiding the costs associated with duplicative efforts and inefficient use of resources.
3. **Global Leadership:** Strategic international engagement positions the U.S. as a global leader in technology and innovation, allowing it to shape international norms, standards and policies in favor of its strategic interests.
4. **Sustained Competitiveness:** Maintaining a leading edge in global innovation ensures that the U.S. remains at the forefront of technological advancements, securing long-term economic and security advantages.

### Contextual Background

The background provided in the NIS emphasizes the pressing need for the U.S. to address its eroding military superiority and the increasing threats posed by rivals and adversaries. The annex builds on this by advocating for international collaboration to enhance national security, drive economic growth and tackle global challenges such as climate change, public health and cybersecurity. By fostering a culture of innovation and engaging in collaborative efforts, the U.S. can fortify its position in the global arena and ensure a sustainable and prosperous future.

The U.S. engagement with the international innovation ecosystem is pivotal to maintaining its global leadership and addressing the multifaceted challenges of the 21st century. This engagement is articulated within the broader framework of the NIS, which emphasizes the need for robust international cooperation to drive technological advancements, enhance economic prosperity and ensure national security. As delineated in the NIS, the security and well-being of the U.S. are under unprecedented threat from rivals and adversaries. Therefore, a proactive and strategic approach to international innovation is imperative.

### Governance Model for U.S. Engagement

The governance model for U.S. engagement in the international innovation ecosystem involves a coordinated effort among major U.S. government organizations, including the White House, federal departments and agencies. This model emphasizes collaboration with the private sector through public-private partnerships to foster innovation and protect national interests.

### Major U.S. Government Organizations

1. **The White House:** Provides strategic direction and policy oversight for national innovation initiatives, ensuring alignment with broader national security and economic objectives
2. **Federal Departments and Agencies:**
  - **Department of Commerce:** Facilitates international trade and investment, supports technology development, and ensures intellectual property protection
  - **Department of Energy:** Leads on energy innovation and collaborates internationally on research and development (R&D) in sustainable technologies
  - **Department of Defense:** Focuses on defense-related technologies and works with allies to enhance military capabilities and innovation
  - **National Institutes of Health (NIH):** Engages in international health research collaborations
  - **National Science Foundation (NSF):** Promotes international scientific partnerships and funding for collaborative research

- **Department of State:** Manages diplomatic efforts to foster international cooperation on innovation
- **Federal Bureau of Investigation (FBI):** Protects against industrial espionage, intellectual property theft and sabotage of U.S. R&D efforts

### Public/Private Partnerships

Public/private partnerships play a critical role in driving innovation and ensuring that the U.S. remains competitive in the global market. These partnerships facilitate:

- Joint research projects and technology transfer
- Development of international standards
- Participation in global innovation networks

### Key Processes and Protective Measures

1. **Committee on Foreign Investment in the U.S. (CFIUS):** This interagency committee reviews foreign investments in U.S. companies to ensure they do not threaten national security. CFIUS plays a crucial role in protecting key U.S. technologies and companies from foreign control.
2. **FBI's Role:** The FBI actively works to prevent industrial property theft and sabotage by monitoring and countering foreign intelligence threats to U.S. innovation sectors.

### SWOT Analysis of U.S. Unified Research, Intelligence and Security

#### Operations Strengths

- **Robust R&D Infrastructure:** The U.S. has a well-established R&D development infrastructure, supported by leading universities and research institutions.
- **Global Leadership:** Strong international influence and leadership in technology and innovation standards
- **Comprehensive Legal Framework:** Effective intellectual property laws and enforcement mechanisms

#### Weaknesses

- **Coordination Challenges:** Difficulty in coordinating efforts across multiple agencies and sectors
- **Resource Allocation:** Limited resources and funding for certain strategic areas of innovation
- **Bureaucratic Hurdles:** Complex regulatory processes can slow down innovation and collaboration efforts.

#### Opportunities

- **Global Collaboration:** Increased opportunities for international partnerships in emerging technologies
- **Talent Acquisition:** Access to a global talent pool through enhanced mobility programs
- **Shared Knowledge:** Potential to leverage global research outputs and best practices

#### Threats

- **Foreign Espionage:** Persistent threats from foreign entities aiming to steal U.S. intellectual property
- **Geopolitical Tensions:** Rising geopolitical tensions that may hinder international collaboration
- **Economic Competition:** Intense global competition for technological dominance

### Navigating the Global Innovation Ecosystem

In the face of rising global challenges, the security and prosperity of the U.S. are increasingly interlinked with the international innovation ecosystem. As articulated in the NIS, maintaining and enhancing U.S. innovative capabilities is crucial for economic growth, national security and global leadership.

#### Australia

- **SWOT Summary:**
  - o **Strengths:** Strong research institutions and innovation in health care and biotechnology
  - o **Weaknesses:** Limited manufacturing capabilities
  - o **Opportunities:** Expansion of renewable energy projects and digital health initiatives
  - o **Threats:** Geographic isolation and reliance on foreign technology

- **Innovation Leadership:** Biotechnology, renewable energy and health care
- **Recommendations:**
  - Strengthen collaboration in renewable energy and health care innovations.
  - Promote research exchanges and joint funding opportunities.
  - Leverage Australia's geographic position to bolster Indo-Pacific innovation networks.

#### Brazil

- **SWOT Summary:**
  - **Strengths:** Biodiversity and agricultural innovation
  - **Weaknesses:** Economic volatility and infrastructural deficits
  - **Opportunities:** Renewable energy projects and agri-tech collaborations
  - **Threats:** Political instability and environmental challenges
- **Innovation Leadership:** Agriculture technology, biofuels and renewable energy
- **Recommendations:**
  - Develop agri-tech and biofuel research partnerships.
  - Facilitate infrastructural development through international investments.
  - Promote sustainable development initiatives to address environmental challenges.

#### Germany

- **SWOT Summary:**
  - **Strengths:** Engineering excellence, robust manufacturing sector and strong R&D investment
  - **Weaknesses:** High labor costs and bureaucratic complexities
  - **Opportunities:** Collaboration in advanced manufacturing and automotive technologies
  - **Threats:** Economic pressures from European Union regulations and global competition
- **Innovation Leadership:** Engineering, automotive technology and manufacturing
- **Recommendations:**
  - Enhance partnerships in advanced manufacturing and automotive innovation.
  - Promote joint R&D initiatives and technology transfer agreements.
  - Facilitate bilateral innovation forums to streamline regulatory challenges.

#### India

- **SWOT Summary:**
  - **Strengths:** Large and growing tech sector, strong IT services and significant talent pool
  - **Weaknesses:** Infrastructure and regulatory challenges
  - **Opportunities:** Collaboration in digital health and renewable energy
  - **Threats:** Political and regulatory instability
- **Innovation Leadership:** IT services, software development and pharmaceuticals
- **Recommendations:**
  - Enhance IT and digital health collaboration.
  - Promote bilateral innovation initiatives to improve regulatory frameworks.
  - Support infrastructure development to bolster innovation ecosystems.

#### Israel

- **SWOT Summary:**
  - **Strengths:** Highly innovative tech sector, strong cybersecurity capabilities and robust startup ecosystem
  - **Weaknesses:** Geopolitical instability
  - **Opportunities:** Joint R&D in cybersecurity and water management technologies
  - **Threats:** Regional security threats impacting stability and investment
- **Innovation Leadership:** Cybersecurity, agri-tech and water technology
- **Recommendations:**
  - Expand cybersecurity and water management partnerships.
  - Facilitate venture capital exchanges and startup incubator collaborations.
  - Promote bilateral innovation forums to address regional stability and technological growth.

## Japan

- **SWOT Summary:**
  - **Strengths:** Known for high-quality, precision engineering, reliability, and thus, global competitiveness; strong R&D culture and work ethics
  - **Weaknesses:** Demographic challenges with an aging population and a shrinking workforce; sometimes bureaucratic process slowing down innovations
  - **Opportunities:** Collaboration in green technologies, shared research in health care and emerging technologies such as artificial intelligence, biotechnology and sustainable energy solutions
  - **Threats:** Economic downturns could impact funding for R&D and innovation initiatives; geopolitical tensions, cybersecurity threats
- **Innovation Leadership:** In technology and electronics, well-developed infrastructure, with strong capabilities in robotics, automotive engineering and consumer electronics
- **Threat Mitigation:**
  - Japan has strong foundations in innovation. It must navigate challenges such as demographic shifts and global competition to maintain and enhance its leadership in technology and other sectors.
  - Engage in more joint ventures for sustainable technology development.
  - Strengthen cybersecurity defenses.

## People's Republic of China (PRC) - Adversarial Nation

- **SWOT Summary:**
  - **Strengths:** Rapid advancements in AI, 5G technology and e-commerce; significant government investment in R&D
  - **Weaknesses:** Intellectual property concerns and lack of transparency
  - **Opportunities:** Collaboration in green technologies and shared research in health care
  - **Threats:** Geopolitical tensions, cybersecurity threats and aggressive economic policies
- **Innovation Leadership:** AI, telecommunications and renewable energy
- **Threat Mitigation:**
  - Strengthen IP protections through bilateral agreements.
  - Enhance cybersecurity defenses and monitor technological exchanges.
  - Engage in joint ventures for sustainable technology development while maintaining strategic caution.

## Russia - Adversarial Nation

- **SWOT Summary:**
  - **Strengths:** Strong aerospace and defense technology sectors; high levels of scientific education
  - **Weaknesses:** Economic instability and limited private sector innovation
  - **Opportunities:** Joint space exploration projects and cybersecurity collaborations
  - **Threats:** Political tensions, cybersecurity threats and military aggressions
- **Innovation Leadership:** Aerospace, defense technology and nuclear energy
- **Threat Mitigation:**
  - Pursue strategic partnerships in space and cybersecurity with clear boundaries.
  - Develop mechanisms to navigate political tensions and focus on scientific collaboration with cautious oversight.
  - Encourage private sector engagement through innovation forums and funding opportunities with stringent security measures.

## Singapore

- **SWOT Summary:**
  - **Strengths:** Strong regulatory environment, financial hub and leading universities
  - **Weaknesses:** Limited natural resources
  - **Opportunities:** Smart city innovations and financial technology (FinTech) collaborations
  - **Threats:** Regional economic competition
- **Innovation Leadership:** FinTech, smart cities and biopharmaceuticals
- **Recommendations:**
  - Strengthen partnerships in FinTech and smart city technologies.
  - Promote educational exchanges and joint research initiatives.
  - Facilitate public-private partnerships to leverage Singapore's financial expertise.

### South Korea

- **SWOT Summary:**
  - **Strengths:** Leading electronics industry, advanced digital infrastructure and significant R&D investment
  - **Weaknesses:** High reliance on export markets
  - **Opportunities:** Collaboration in digital technologies and renewable energy
  - **Threats:** Geopolitical tensions with North Korea and regional competition
- **Innovation Leadership:** Electronics, digital innovation and automotive technology
- **Recommendations:**
  - Enhance collaboration in digital technologies and smart manufacturing.
  - Promote joint R&D initiatives and technology transfer agreements.
  - Support bilateral innovation forums to address geopolitical and economic challenges.

### Sweden

- **SWOT Summary:**
  - **Strengths:** Strong emphasis on sustainability, high R&D investment and robust educational system
  - **Weaknesses:** Small domestic market
  - **Opportunities:** Collaboration in green technologies and sustainable development
  - **Threats:** Economic pressures from global competition
- **Innovation Leadership:** Green technologies, sustainability and advanced manufacturing
- **Recommendations:**
  - Develop partnerships in renewable energy and sustainability initiatives.
  - Facilitate joint research projects and technology transfer agreements.
  - Promote educational exchanges to leverage Sweden's expertise in sustainability.

### Switzerland

- **SWOT Summary:**
  - **Strengths:** Strong pharmaceutical and biotechnology sectors, robust financial services and high R&D investment
  - **Weaknesses:** High cost of living and doing business
  - **Opportunities:** Collaboration in pharmaceuticals, biotech and financial technologies
  - **Threats:** Regulatory complexities and economic pressures
- **Innovation Leadership:** Pharmaceuticals, biotechnology and financial services
- **Recommendations:**
  - Enhance partnerships in biotechnology and pharmaceuticals.
  - Promote joint R&D initiatives and technology transfer agreements.
  - Facilitate financial technology collaborations to leverage Switzerland's expertise.

### Taiwan

- **SWOT Summary:**
  - **Strengths:** Leading semiconductor industry and advanced manufacturing
  - **Weaknesses:** Political pressure from China
  - **Opportunities:** Collaboration in semiconductor research and AI development
  - **Threats:** Geopolitical instability and supply chain vulnerabilities
- **Innovation Leadership:** Semiconductors, electronics and AI.
- **Recommendations:**
  - Develop joint ventures in semiconductor R&D.
  - Enhance supply chain resilience through diversified partnerships.
  - Promote technology transfer agreements to support mutual growth.

This annex provides a detailed analysis of key multinational corporations and international organizations involved in innovation activities. By examining their strengths, weaknesses, opportunities and threats (SWOT), we can strategically enhance U.S. engagements to foster a cooperative, innovative and secure global environment.

## U.S. Engagement With Key Multinational Corporations and International Organizations Within the International Innovation Ecosystem

### Alphabet Inc. (Google)

- **SWOT Summary:**
  - **Strengths:** Dominant in AI, data analytics and cloud computing
  - **Weaknesses:** Regulatory scrutiny and privacy concerns
  - **Opportunities:** Expansion in health care technology and quantum computing
  - **Threats:** Antitrust actions and cybersecurity threats
- **Innovation Leadership:** AI, cloud computing and data analytics
- **Recommendations:**
  - Strengthen collaborations in AI ethics and quantum computing.
  - Foster joint ventures in health care technology.
  - Enhance cybersecurity measures through public-private partnerships.

### Amazon

- **SWOT Summary:**
  - **Strengths:** E-commerce dominance, cloud services (AWS) and logistics
  - **Weaknesses:** Labor practices and antitrust issues
  - **Opportunities:** AI-driven logistics and health care services
  - **Threats:** Regulatory challenges and cybersecurity risks
- **Innovation Leadership:** E-commerce, cloud computing and logistics
- **Recommendations:**
  - Collaborate on logistics and AI innovation.
  - Develop frameworks for ethical labor practices and regulatory compliance.
  - Enhance cybersecurity collaboration and standards.

### International Organization for Standardization (ISO)

- **SWOT Summary:**
  - **Strengths:** Global standard-setting authority, cross-industry influence
  - **Weaknesses:** Slow adaptation to rapid technological changes
  - **Opportunities:** Leading in cybersecurity and sustainable development standards
  - **Threats:** Geopolitical influences and competing standards bodies
- **Innovation Leadership:** Standardization across multiple industries
- **Recommendations:**
  - Promote U.S. leadership in setting new technology and cybersecurity standards.
  - Encourage participation in ISO committees to influence emerging standards.
  - Foster collaboration on sustainability and smart infrastructure standards.

### International Telecommunication Union (ITU)

- **SWOT Summary:**
  - **Strengths:** Global influence on telecommunications standards and policies
  - **Weaknesses:** Bureaucratic processes and susceptibility to geopolitical tensions
  - **Opportunities:** 5G, IoT and cybersecurity advancements
  - **Threats:** Influence from adversarial nations and politicization of standards
- **Innovation Leadership:** Telecommunications and ICT standards
- **Recommendations:**
  - Strengthen U.S. engagement in ITU to shape 5G and IoT standards.
  - Promote democratic principles and transparency in ITU processes.
  - Counter adversarial nation influence through strategic alliances.

### Microsoft

- **SWOT Summary:**
  - **Strengths:** Software innovation, cloud services (Azure) and enterprise solutions
  - **Weaknesses:** Legacy system integration and antitrust issues
  - **Opportunities:** Expansion in AI, cybersecurity and cloud computing
  - **Threats:** Regulatory scrutiny and cyber threats

- **Innovation Leadership:** Software, cloud computing and cybersecurity
- **Recommendations:**
  - Enhance collaboration in AI and cybersecurity research.
  - Develop joint initiatives for cloud computing innovations.
  - Advocate for balanced regulatory frameworks to foster innovation.

#### Siemens

- **SWOT Summary:**
  - **Strengths:** Industrial automation, smart infrastructure and renewable energy technologies
  - **Weaknesses:** Complex organizational structure and competition in core markets
  - **Opportunities:** Smart cities, industrial IoT and renewable energy
  - **Threats:** Geopolitical risks and supply chain vulnerabilities
- **Innovation Leadership:** Industrial automation, smart infrastructure and energy
- **Recommendations:**
  - Foster partnerships in smart infrastructure and renewable energy.
  - Promote joint research in industrial IoT and automation.
  - Enhance supply chain resilience through diversified partnerships.

Additional prominent organizations dedicated to innovation that exert influence include:

- [DIU](#): Defense Innovation Unit
- [NSIN](#): National Security Innovation Network under DIU
- [NIF](#): NATO Innovation Fund & DIANA launched as part of NATO 2030
- [World Economic Innovators](#): World Economic Forum’s Innovator Communities
- [WIPO](#): World Intellectual Property Organization under the United Nations
- [EIT](#): European Institute of Innovation and Technology (EIT)

### Multinational Corporations and Organizations Influenced by Adversarial Nations

#### Huawei

- **SWOT Summary:**
  - **Strengths:** Leading in telecommunications equipment and 5G technology
  - **Weaknesses:** Dependence on Western semiconductor technology
  - **Opportunities:** Expansion in AI and consumer electronics
  - **Threats:** U.S. and allied sanctions, cybersecurity concerns and espionage risks
- **Innovation Leadership:** 5G technology and telecommunications equipment
- **Adversary Influence:** Directly influenced by the Chinese government, posing espionage and security risks
- **Mitigation Strategies:**
  - Enforce strict export controls and sanctions.
  - Promote alternative 5G solutions from allied nations.
  - Enhance cybersecurity measures and intelligence sharing with allies.

#### United Nations (UN)

- **SWOT Summary:**
  - **Strengths:** Global platform for addressing international issues, including innovation and development
  - **Weaknesses:** Bureaucratic inefficiencies and susceptibility to politicization
  - **Opportunities:** Leadership in sustainable development and global health innovations
  - **Threats:** Influence from adversarial nations and insufficient funding
- **Innovation Leadership:** Sustainable development and global health
- **Adversary Influence:** Potential manipulation by adversarial nations to skew global policies and innovation priorities
- **Mitigation Strategies:**
  - Increase linkage of the significant U.S. financial contributions to U.S. strategic goals and require key leadership roles within UN bodies for the U.S. and its allies.
  - Promote transparency and accountability in UN initiatives decreasing or eliminating funding where the UN negatively impacts the strategic goals of the U.S. and its allies.
  - Strengthen alliances with like-minded nations to counter adversary influences, and link U.S. foreign aid to the recipients’ actions within the UN and other International Standards Organizations.

## General Strategy for Improvement Strategies to Counter Malign Influences

- 1. Enhance Intelligence and Cybersecurity:**
  - Strengthen intelligence-sharing agreements with allies.
  - Develop comprehensive cybersecurity strategies to protect critical infrastructure and sensitive data.
  - Monitor and counteract espionage activities by adversarial nations.
- 2. Promote Democratic Values and Transparency:**
  - Advocate for transparent and democratic processes in international organizations.
  - Support initiatives that promote freedom of information and ethical standards.
  - Engage in public diplomacy to highlight the benefits of democratic innovation practices.
- 3. Strengthen Economic and Technological Alliances:**
  - Form strategic alliances with key innovation leaders to create resilient supply chains and reduce dependency on adversarial nations.
  - Promote joint R&D projects and technology transfer agreements with trusted partners.
  - Encourage cross-border investments in critical technologies and infrastructure.
- 4. Implement Targeted Sanctions and Export Controls:**
  - Enforce targeted sanctions against entities involved in espionage and malicious cyber activities.
  - Implement export controls on sensitive technologies to prevent their misuse by adversarial nations.
  - Coordinate with allies to ensure a unified approach to sanctions and export controls.

## Governance Model Enhancements

- 1. Enhanced Coordination:** Establish a centralized coordinating body to streamline efforts across federal departments and agencies.
- 2. Increased Funding:** Allocate more resources to strategic areas of innovation, particularly those with high national security implications.
- 3. Simplified Regulations:** Streamline regulatory processes to facilitate faster innovation and collaboration.

## Strengthening Unified Research, Intelligence and Security Operations

- 1. Improved Information Sharing:** Enhance mechanisms for sharing information and intelligence between government agencies and private sector partners.
- 2. Advanced Cybersecurity Measures:** Invest in advanced cybersecurity technologies and protocols to protect critical infrastructure and intellectual property.
- 3. International Engagement:** Foster stronger international alliances to counteract espionage and promote collaborative innovation efforts.

In conclusion, by refining its governance model and strengthening unified research, intelligence and security operations, the the United States can better engage with the international innovation ecosystem, securing its position as a global leader and safeguarding its national interests.

# Annex 2: State, Local, Tribal and Territorial (SLTT) Engagement

## Introduction

This annex on State, Local, Tribal and Territorial (SLTT) Engagement is a supporting document for this National Innovation Strategy (NIS) developed by the Cyber Committee of AFCEA International and various innovation practitioners and experts.

This annex covers federal engagement with state, local, tribal and territorial entities.

The NIS is a visionary blueprint designed to position the U.S. at the forefront of global competitiveness through advanced innovation practices. By fostering cross-sector collaboration and leveraging cutting-edge technologies and novel business models, the NIS aims to address critical challenges and capitalize on emerging opportunities. This strategy underscores the indispensable role of innovation in securing national security, sustaining economic prosperity and advancing societal well-being.

AFCEA International is a nonprofit organization dedicated to connecting people, ideas and solutions globally. Founded in 1946, AFCEA serves as a hub for professionals in defense, intelligence and security sectors, promoting dialogue and collaboration between government, industry and academia. AFCEA International's Cyber Committee is a specialized group

within the organization that focuses on cybersecurity challenges and opportunities. This committee brings together experts to share insights, develop solutions and promote best practices in cybersecurity. Through initiatives like the National Innovation Strategy, the Cyber Committee aims to enhance the nation's resilience against cyber threats and drive forward-thinking approaches to innovation in the digital age.

## ***National Innovation Strategy State, Local, Tribal and Territorial (SLTT) Annex***

This document is a stand-alone annex describing a State, Local, Tribal and Territorial (SLTT) government innovation strategy as a component of a larger recommended National Innovation Strategy (NIS).

### **RECOMMENDATIONS SUMMARY**

The following recommendations for SLTT-based innovation are described in more detail below.

1. Expand and coordinate existing SLTT-focused federal innovation programs, with state-level economic development organizations as the focal point.
2. Use government funding to focus on community-driven, commercial-first innovation.
3. Use vendor engagement/contractual mechanisms that encourage private intellectual property (IP), reduce risk and provide rapid demonstration and feedback.
4. Focus on pre-operational pilot projects for community resilience, broadly defined.
5. Enable implementation of a trusted public data infrastructure.
6. Establish reference implementations of significant capabilities that focus on open architectures and economic models that support local affordability of the operations and maintenance.
7. Establish a knowledge-sharing mechanism to encourage exchange of ideas among participating communities.
8. Establish or engage a broadly available purchasing mechanism for SLTT entities interested in rapid acquisition.

### **EXECUTIVE SUMMARY**

Why SLTT?

The federal government, most notably DoD components and their industry and university partners, have long been the backbone of innovation in the United States. Why is there a need for a new role for SLTT in the national innovation system?

For starters, times have changed. Climate change is increasingly felt at the local community level, with communities all along the East and Gulf Coasts and elsewhere dealing with persistent coastal flooding and inland communities dealing with the effects of increasingly frequent and violent weather. External threats from nation-states using drones or the digital weapons of cyberspace or economic and political influence campaigns, now reach through the traditional protective umbrella of our national security apparatus to directly threaten businesses and critical infrastructure. In many cases, critical infrastructure is owned and operated by SLTT or quasi-governmental SLTT organizations: roadways, power infrastructure, government agency facilities and more.

So too, many of the assets that respond to natural and human-caused emergencies are SLTT assets. Fire and police, local government departments that support public utilities, schools and hospitals all play a role when a response is required. No matter the situation, the first response is always local, but few innovation ecosystem assets focus on the needs of these communities and responders. Geography, local knowledge and cultural norms and proximity to the needs all matter. Building community resilience in the face of these challenges is a key SLTT challenge.

Finally, economic security goes hand in hand with national security. Federal innovation strategies can provide large levels of support across broad regions, but these are not equally distributed. Those best positioned to secure the benefits of federal programs are generally clustered in the urban areas and academic centers already realizing the benefits of innovation. Furthermore, there is a new urgency around modernizing our crumbling infrastructures for transportation, water and power, as well as building new digital infrastructure to support continued growth in the 21st century.

A truly effective NIS will find ways to ensure those benefits are shared across the spectrum, and SLTT entities are both chartered and positioned to be the intermediaries for those benefits.

## A New Model for Innovation

There is increasing realization at the federal level of the need for robust SLTT innovation. Recent initiatives such as the CHIPS Act or Build Back Better look to incentivize regional collaborations around new infrastructure, and these initiatives have had some success. The National Science Foundation (NSF) has established a Regional Innovation Engines program to seed a variety of innovation ecosystems across the country. Yet despite their successes, these and similar federal programs are one-time or sporadic sources of funding and may lack long-term sustainability or focus.

Developing a new persistent, self-sustaining model for SLTT innovation requires an understanding of the models that currently exist. Since World War II, perhaps the most prominent model is what is colloquially known as the “military-industrial complex.” Based on the success of technology innovation in helping to win that war, the model consists of direct federal funding to universities and other research centers such as national laboratories to develop intellectual property and related innovations, and then license or otherwise transfer that know-how to industry partners to produce products for national level uses, including most prominently national defense. While this model has served (and will certainly continue to serve) the country well, it has several weaknesses:

- The cycle time from need to product can often be measured in decades.
- The transition from research to product is difficult, resulting in the well-known “Valley of Death” where even strong innovations can fail.
- Research protocols may result in outcomes that are too expensive, too inefficient, too difficult to use or simply no longer fit a need.
- Research entities have a variety of structural elements that limit a focus on commercialization.
- A second model has been the evolution of the corporate laboratory. While the military-industrial model described above worked most effectively when the federal government was both the biggest funder and the biggest customer, that situation changed in the 1990s as corporate investment became the predominant model and federal purchasing power declined relative to consumer purchasing power.

Classically, the labs of IBM (computers), Bell Laboratories (communications) or RCA (television/HDTV) have produced significant national outcomes. However, it is difficult for centralized labs to remain relevant and productive over the long term or to address needs outside of their core competencies. Of the three cited above, only IBM has managed this process effectively over decades, first transforming from a mainframe company into a services-oriented business in the 1990s and now providing leadership in AI and quantum computing. Additionally, as private enterprises, these corporate innovation centers are not well-equipped to service needs where a profitable market does not exist; community resilience and emergency response, for example, are not generally seen as profitable areas for investment.

More recently, venture capital-backed innovation has been in vogue, with Silicon Valley the canonical example. This process has effectively harnessed the innovative energy of entrepreneurs and produced 21st century innovation examples of mobile/wireless communications and devices, rapid access to enormous information assets and global connectivity. Here the limitations are now becoming clear, with again the limitations of private interests in public goods, to say nothing of the behavioral changes or growth of misinformation peculiar to the specific innovations.

A new model for SLTT innovation should harness the best aspects of these existing models while simultaneously addressing some of the shortcomings to open new areas for innovative activity. Such a model should:

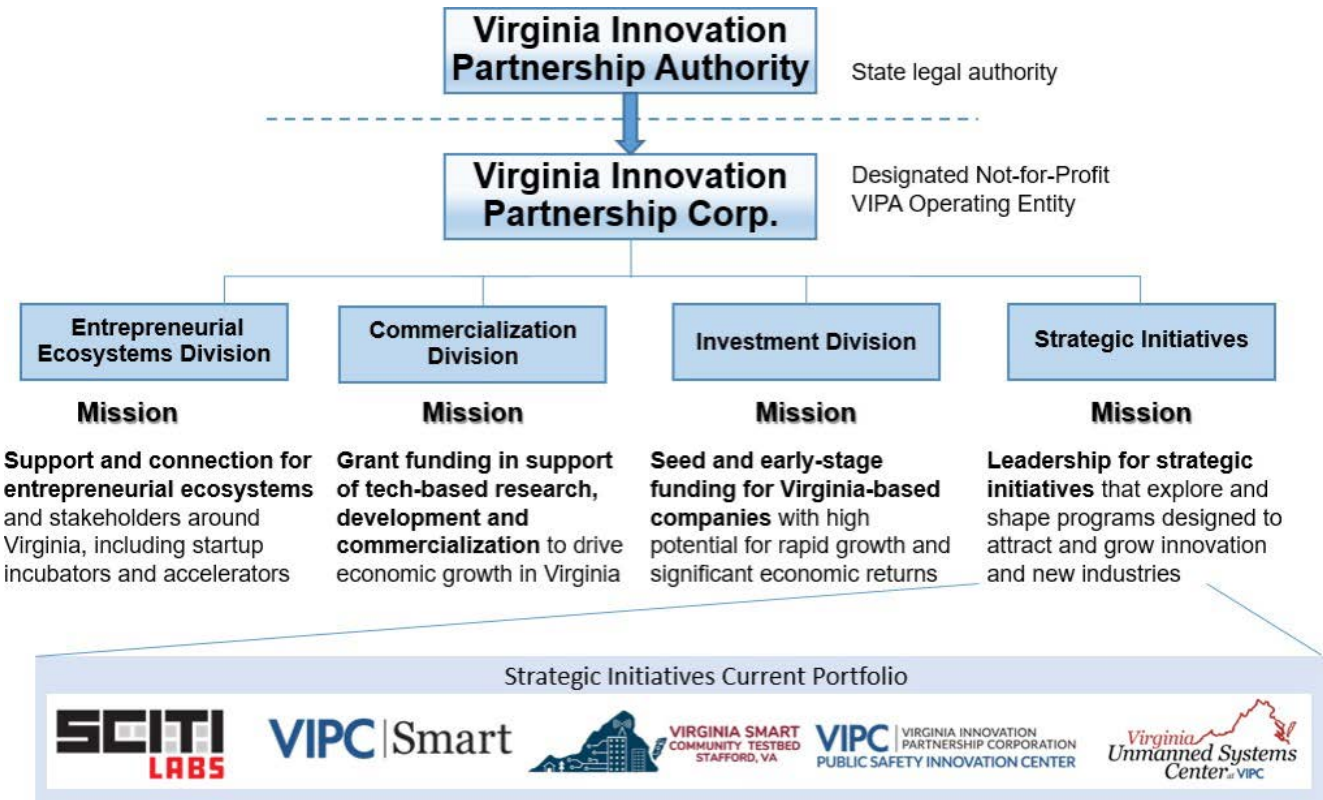
- Integrate a federal government role to take advantage of the enormous potential federal capacity for funding and scaling innovation.
- Take advantage of the localized knowledge and charter of SLTT entities.
- Continue to harness entrepreneurial energy.
- Focus on the growing needs for public goods related to community resilience, emergency management, digital competencies and economic development.

Examples embodying this new type of innovation model exist in several places. Innovation districts are popping up in urban areas from Austin to the Research Triangle and beyond, seeking to capture entrepreneurial energy and potential venture funding at a local level. Massachusetts is one of the more mature models, building on the high-end workforce of its leading universities, close-knit support from the local and state governments and innovation partners, such as Massport, leading the way for innovation in the transportation network. The outcome has been a powerhouse ecosystem across a range of industry sectors, including information sciences and health care and pharmaceuticals.

Massachusetts started with significant advantages in terms of world-class universities co-located with both local and state government entities, as well as numerous industry partners; it has capitalized on those assets in a hugely beneficial process. However, the scalability of the Massachusetts approach is not clear for SLTT entities that do not have such inherent advantages. Virginia provides an alternative example.

### VIRGINIA USE CASE EXAMPLE FOR SLTT INNOVATION

The Virginia Innovation Partnership Corporation (VIPIC) is a state-chartered 501(c)3, created by the Commonwealth of Virginia to lead the way in technology-based economic development activities. VIPIC’s efforts have contributed to Business Facilities Magazine recognizing Virginia as the leading state for cybersecurity, unmanned aerial systems (UAS) and digital infrastructure, as well as third for workforce development. The VIPIC team has in place an existing regional-scale, technology-driven



innovation ecosystem with proven outcomes, embodying a public-private partnership incorporating federal, state and local investment and private partner participation. VIPIC brings these organizations together to leverage each of their capabilities, creating a unique ecosystem that activates all the necessary elements to drive innovation to impact under one virtual roof.

The strategic initiatives division is the forward-looking technology portfolio for the commonwealth, sourcing and conducting exploratory pilot projects with new and emerging technologies. The division is organized into several mission-focused centers for unmanned systems, public safety, smart communities and smart data, as well as SCITI Labs, an ongoing DHS-funded program for “commercial first innovation.”

VIPIC has demonstrated a wide range of success in sourcing, assessing, evolving and integrating emerging and innovative capabilities into commercial market-ready solutions. Since VIPIC and its core partners are direct investors in the evolving technology and venture ecosystem (rather than an outsider), the organization can source a broad array of emerging, near-commercial, adjacent market innovators and other nontraditional government vendors. The graphic illustrates some of the process and numbers from the initial Commercial First contract.

VIPIC has established a network of living laboratories throughout Virginia and the region to provide proving ground venues for both developmental test and evaluation (DT&E) as well as operational test and evaluation (OT&E). Unlike typical university research or national laboratories, these living laboratories are operational facilities or localities that agree to implement, test and evaluate new technologies in operational settings with end users. A few examples include airspace awareness/counter-drone sensors in and around the state capitol in Richmond; sensor feeds to the Department of Emergency Management Mobile Command Center for overwatch operations in support of the annual Apple Blossom Festival in Winchester; and

in-building sensing and analytics capability at Capital One Arena in Washington, D.C. The world-famous Virginia Smart Community Testbed in Stafford County has hosted numerous federal and international partner visits and has recently been [published as a case study by the World Economic Forum](#).

As a key component of the public-private partnership model, many of the testbed technologies have been funded by DHS. The commonwealth has provided substantial additional funding, and the testbed facility itself is owned and operated by the local county government to serve as a proving ground and source of expertise for any locality that wishes to engage.

VIPC actively engages an extensive ecosystem of innovation partners, both public and private, as indicated in the diagram below. Its position as a not-for-profit state authority helps enable the integration of the various levels of government and government agencies. The economic development role engaging with early-stage innovators ensures ready access to the innovation community. On the academic side, VIPC not only engages directly with universities such as Old Dominion, George Mason and Virginia Tech, but also participates in advisory boards and other oversight roles for commonwealth academic innovation groups such as the Commonwealth Cyber Initiative ([CCI](#)) and the Virginia Academy of Science, Engineering and Medicine ([VASEM](#)).

More details on this functioning innovation ecosystem are found in the body of this annex.

## SLTT INNOVATION RECOMMENDATIONS

Based on these considerations, the following recommendations summarize a new model for SLTT innovation:

1. Expand and coordinate existing SLTT-focused federal innovation programs, with state-level economic development organizations as the focal point. The federal government has the capacity to provide substantial amounts of funding but generally lacks the local purview and presence. Local governments are positioned to have direct impacts on their local situations but may choose point solutions that are not consistent or scalable across a region. State-level entities or similar territorial or tribal units are uniquely positioned to coordinate across these levels of government.
2. Use government funding to focus on community-driven, commercial-first innovation. While state-level entities can provide regional solutions and consistency, the people and organizations required for implementation, transition and adoption of new capabilities are generally local. “Community-driven” implies more than simply opt-in; it helps ensure local buy-in and leadership for incorporating innovation. “Commercial-first” is an approach that drives innovation via early-stage innovators and entrepreneurs seeking to address specific market needs. This approach helps shift the focus from “technology push” to “market pull” innovations and ensure both more sustainable business models as well-established entities to carry innovations forward.
3. Use vendor engagement/contractual mechanisms that encourage private intellectual property, reduce risk and provide rapid demonstration and feedback. The SBIR/STTR program has had a large positive impact over an extended period along these lines, although it focuses primarily on the defense (or federal) industrial base more so than commercial success of small innovators. For these companies to have the ability to secure outside commercial funding, the government engagements must be supportive of innovation development, low risk and not encumber any IP of the entity.
  - While this has classically meant cost-reimbursable contracts for delivery of innovation, that approach immediately excludes innovators without a government-approved accounting system (many early-stage innovators) and generally includes government- purpose rights to IP, making the company noninvestable. Furthermore, at the early stages of innovation, the government generally derives no value from rights in immature IP. As an alternative, fixed-price contracts, where the deliverables are merely demonstrations and documentation of evolving capabilities, avoid these issues. A demonstration is a low-risk contractual deliverable, while government interests are preserved by evaluating the value of incremental demonstrations of emerging capabilities. Finally, a process of quarterly or similar tempo demonstrations ensures rapid iteration toward achieving defined use cases.
4. Focus on pre-operational pilot projects for community resilience, broadly defined. Many of the SLTT challenges of today are based around inexorable forces: climate change and increasing weather impacts; aging infrastructure for power, communications, transportation and others; and, increasingly, hostile nation-state actions that are directed at local communities in various ways, from health care systems to financial institutions to food security. Technologies exist or can be developed to lessen these impacts and introduce new capabilities and services, but the capacity of local communities to integrate and support these evolving capabilities is often limited. A focus on community resilience supports development of relevant technologies and approaches across a broad range of community challenges. Pre-operational pilot projects demonstrate in practical terms the capabilities of new approaches and provide an opportunity for communities to develop hands-on expertise in the process of transition and integration.

5. Enable implementation of a trusted public data infrastructure. A major impediment to broader adoption of digital technologies by SLTT entities is the infrastructure for moving and handling data. Issues include siloed cloud-based services, inadequate cybersecurity, high hurdles for data sharing, vendor-driven solutions that seek to lock in platforms and data ownership and others. A public data infrastructure provides a mechanism for common data security, data transport, data ownership and governance that is freely available to local communities who can then build sensor networks, analytic capabilities, public-facing applications and other value-added features without needing to reinvent the basic infrastructure each time. As the power grid accepts electrons from many sources and makes them available to many devices and uses, so too the public data infrastructure performs those functions for data.
6. Establish reference implementations of significant capabilities that focus on open architectures and economic models that support local affordability of the operations and maintenance. For innovation to survive in SLTT environments, there needs to be an affordable ongoing economic model that does not depend on specific vendor implementations to survive. An open architecture helps ensure that critical components can be updated or replaced as technology evolves. A reference architecture with an affordable, sustainable cost point establishes a proven, functional value proposition that other market-based solutions must be able to better.
7. Establish a knowledge-sharing mechanism to encourage exchange of ideas among participating communities. Such mechanisms exist among various stakeholders in the SLTT ecosystem, with those that are known access points to information and more importantly personal connections to colleagues with experience meeting similar community needs, providing the highest value.
8. Establish or engage a broadly available purchasing mechanism for SLTT entities interested in rapid acquisition. A desirable outcome is the ability to rapidly scale successful innovations, although it is easy to conflate vertical integration into larger offerings with horizontal scaling from one community to many. Additionally, SLTT procurement regulations can often cause significant delays before budget can be allocated, a procurement conducted and competitive outcomes not necessarily favoring innovative approaches. Even the ability of SLTT entities to try out or pilot new technologies may be hampered. Mechanisms such as approved vendor lists, the DHS SAFETY Act that helps reduce liability or SLTT blanket purchasing agreements at least for pilot projects up to some dollar limit (\$100,000 for example) would significantly help smaller early-stage innovators.

AFCEA's Committees produce topical white papers that highlight critical issues and propose solutions. To see submissions and review the extensive collection of relevant materials, please visit [AFCEA's Resource Library](#).



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Final Version for U.S. Government