


Chapter 12: Intellectual Property



Intellectual Property Policy is a National Security Priority



Issue Executive Order on IP for AI and Emerging Technologies.



Develop Plan to Reform and Establish IP Policies and Regimes.



Assess “IP Considerations.”



Propose Executive and Legislative Actions.




Integrate into National Security, Economic, and Technology Competitiveness Strategies.

China is both leveraging and exploiting intellectual property (IP) policies as a critical tool within its national strategies for emerging technologies. The United States has failed to similarly recognize the importance of IP in securing its own national security, economic interests, and technology competitiveness. The U.S. has not developed comprehensive IP policies to incentivize investments¹ in and protect the creation of artificial intelligence (AI) and other emerging technologies.² The consequence of this policy void—which includes legal uncertainties created by current U.S. patent eligibility and patentability doctrine, the lack of an effective response to China’s domestic and geopolitical strategies centered on its IP institutions,³ and the lack of effective data protection policies—is that the U.S. could lose its prime position in IP global leadership. At the same time, by strengthening its IP regimes,⁴ China is poised to “fill the void” left by weakened U.S. IP protections, particularly for patents, as the U.S. has lost its “comparative advantage in securing stable and effective property rights in new technological innovation.”⁵ This stark policy asymmetry has multiple significant domestic and international implications for the U.S.

First, U.S. courts have severely restricted what types of computer-implemented and biotech-related inventions can be protected under U.S. patent law.⁶ Critical AI and biotech-related inventions have been denied patent protection since 2010.⁷ Facing uncertainty in obtaining and retaining patent protection, inventors pursue trade secret protection. Trade secrets do not readily promote innovation markets, because trade secrets, unlike patents, do not contribute to accessible technical knowledge in the public domain.⁸ While these impacts might not be immediate, the long-term effects on AI and other emerging technology developments and competitiveness are concerning.⁹

Second, China has met its strategic policy goal of increasing the quantity of its patent applications and issued patents, creating the narrative that it has “won” the innovation race. In 2019, the total number of “invention” patent applications filed at the China National Intellectual Property Administration (CNIPA) was approximately three times as many as utility patent applications filed at the U.S. Patent and Trademark Office (USPTO).¹⁰ China also led the world in international patent applications under the Patent Cooperation Treaty (PCT) system of the World Intellectual Property Organization (WIPO).¹¹ Critically, China is now frequently identified as the current leader in domestic patent application filings for AI inventions.¹² Globally, AI patent applications originating from China outnumber those originating from the United States, especially in recent years.¹³



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China's National IP Regimes for AI and Emerging Technologies

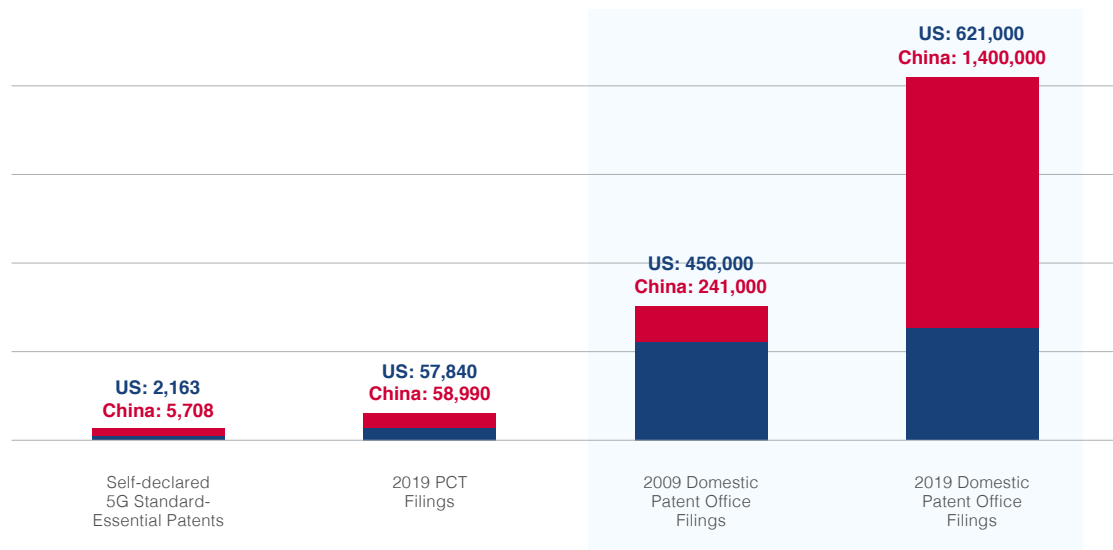
National 13th Five-Year Plan for the Development of Strategic Emerging Industries articulates IP-related goals for emerging technologies:

- Revising the Patent Law and Copyright Law
- Strengthening IP rights protections through rapid rights protection centers
- Developing strategic advancement plans for IP rights of emerging technologies
- Improving overseas IP rights and supporting companies involved in overseas M&A

Patent filings are incentivized by:

- Patent subsidies
- Rewards for granted patents
- Patent quotas set by provincial or municipal governments
- Preferential treatment in government procurement processes for companies with Chinese IP


Patent protection is increased through preliminary injunctions for patent infringement, increases in punitive damages for IP infringement (allows for quintuple damages for willful infringement), and specialized IP courts with efficient resolution and low litigation costs.



CSET Translation of *National 13th Five-Year Plan for the Development of Strategic Emerging Industries*, Central Committee of the Communist Party of China and the PRC State Council (Published Nov. 29, 2016) (translation by CSET on Dec. 9, 2019), <https://cset.georgetown.edu/research/national-13th-five-year-plan-for-the-development-of-strategic-emerging-industries/>; Eric Warner, *Patenting and Innovation in China: Incentives, Policy, and Outcomes*, RAND at 17-18 (Nov. 2014), <https://apps.dtic.mil/dtic/tr/fulltext/u2/a619128.pdf>; Trademarks and Patents in China: *The Impact of Non-Market Factors on Filing Trends and IP Systems*, U.S. Patent and Trade Office (Jan. 2021), <https://www.uspto.gov/sites/default/files/documents/USPTO-TrademarkPatentsInChina.pdf>; Ryan Davis, *4 Things to Know About China's Revised Patent Law*, Law 360 (Nov. 5, 2020), <https://www.law360.com/articles/1326419>; Justice Tao Kaiyuan, *China's Commitment to Strengthening IP Judicial Protection and Creating a Bright Future for IP Rights*, WIPO Magazine (June 2019), https://www.wipo.int/wipo_magazine/en/2019/03/article_0004.html.

Note: The self-declared 5G standard-essential patent numbers are as of February 2020 and represent the combined total from the two companies that are the largest filers in each country. For the United States, 2,163 represents the 1,293 applications filed from Qualcomm and 870 from Intel. For China, 5,708 represents the 3,147 filed from Huawei and 2,561 filed from ZTE. This number also represents the standard-essential patents filed, not the number of patents granted. See Jed John Ikoba, *Huawei Has Filed the Most 5G Patents Globally as of February 2020 - Report*, Gizmochina (June 2, 2020), <https://www.gizmochina.com/2020/06/02/huawei-has-the-most-5g-standard-essential-patents-globally/>; *China Becomes Top Filer of International Patents in 2019 Amid Robust Growth for WIPO's IP Services, Treaties and Finances*, WIPO Media Center (Apr. 7, 2020), https://www.wipo.int/pressroom/en/articles/2020/article_0005.html; For the domestic patent office filings, according to the China National Intellectual Property Administration (CNIPA), "the number of invention patent applications it received increased by more than 500 percent between 2009 and 2019, from 241,000 to 1.4 million (although, interestingly, there was a 9 percent decrease from 2018 to 2019). In comparison the number of patent applications at the

USPTO increased by only 35% (from 456,000 to 621,000) over the same period. Hence, while in 2009 U.S. patent applications outnumbered Chinese applications by almost two-to-one, by 2019, the ratio had completely reversed. Most of the Chinese patenting increase can be attributed to applications filed by domestic applicants. Out of the 1.4 million CNIPA applications in 2019, domestic sources filed almost 90 percent (compared to 48 percent of USPTO applications).” See Patrick Thomas & Dewey Murdick, *Patents and Artificial Intelligence: A Primer*, Center for Security and Emerging Technology at 10 (Sept. 2020), <https://cset.georgetown.edu/wp-content/uploads/CSET-Patents-and-Artificial-Intelligence.pdf>. In 2019, there were also almost two million utility model applications in China. *Id.* at n. 17.



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Third, regardless of quality concerns,¹⁴ China’s prolific patent application filings may further hurt U.S. innovators by creating a vast reservoir of “prior art” (the term in patent law for the worldwide scientific and technical knowledge by which an invention is evaluated to determine if it is new). This dramatically increases the quantity of prior art that must be reviewed in examining a patent application. As a result, the patent examination process at the USPTO will become increasingly difficult, if not onerous. At the same time, U.S. inventors may find it more difficult to obtain patents because they must show that their inventions are not disclosed in the prior art publications anywhere in the world, including in the Chinese-language patent applications filed in China and internationally.¹⁵ As Chinese patents come to dominate prior art searches by patent offices throughout the world, the current dominance of U.S. patents in worldwide prior art searches will erode.¹⁶

Fourth, and consistent with China’s extensive patent application filings, China’s companies have been identifying too many patents as “standard-essential” in standards development organizations, alleging that these patents must be practiced to comply with a technical standard.¹⁷ Although standard development organizations require patent owners to self-identify patents that may be deemed essential in future standards, these organizations leave final essentiality determinations to private companies negotiating licenses or, if there is a dispute, to courts.¹⁸ This practice of “overdeclaring” standard-essential patents (SEPs) furthers China’s global narrative that it has “won” the race to such standardized

technologies as 5G, prompting other countries to adopt China's technologies in their own communications infrastructures.¹⁹ A worrisome result may be that U.S. companies must pay billions in royalties to China's companies or face claims and resulting litigation that they willfully infringed on Chinese company patent rights.²⁰

Fifth, the lack of explicit legal protections for data or express policies on data ownership may hinder innovation and collaboration, particularly as technologies evolve.²¹ The absence of data protection regimes may disincentivize parties from making necessary investments to develop data sets that are critical for machine learning (ML) and AI systems.²² Additionally, the absence of data governance policies (such as contracting best practices) for IP-type protections or ownership rules could undermine the willingness of companies to enter into the public-private partnerships that are crucial for creating cutting-edge technological innovations.²³ This could also create challenges for U.S. collaboration with allies and other partners in vital AI R&D where data rights or ownership claims come into question.²⁴

Lastly, as further evidence that China views IP as essential in its domestic economic development, China continues to pervasively steal American IP-protected technological advances through varied means like cyber hacking of businesses and research institutes, technological espionage, blackmail, and illicit technology transfer.²⁵




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The IP Policy Void.

The U.S. Government needs to address these vulnerabilities resulting from the lack of comprehensive IP policies. Currently, the U.S. Government does not efficiently utilize IP policy as a tool to support national strategies for national security, economic interests, and technology competitiveness in AI and emerging technologies. The majority of the United States Government's coordinated IP policy efforts are focused on IP enforcement and preventing IP theft.²⁶ The U.S., however, lacks an agency or interagency entity that is empowered to both develop and execute national IP policies that support and integrate with national strategies. As a result, the United States lacks cohesive, legislatively mandated AI and emerging-technology IP policies that are integrated into national strategy frameworks to address, for example, global competition from countries like China.

America's IP laws and institutions must be considered as critical components for safeguarding U.S. national security interests, including advancing economic prosperity and technology competitiveness. The United States must, at a minimum, articulate and develop national IP reforms and policies with the goal of incentivizing, expanding, and protecting AI and emerging technologies, at home and abroad. Such policies should be developed and proposed via the Executive Branch with a process that integrates the disparate departments and agencies that serve important roles in promoting U.S. innovation. The Executive Branch should:



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Recommendation

Develop and implement national IP policies to incentivize, expand, and protect AI and emerging technologies. The President should issue an executive order to recognize IP as a national priority and require the development of a comprehensive plan to reform and create IP policies and regimes that further national security, economic interests, and technology competitiveness strategies. The Commission recommends that the executive order direct the Vice President, as chair of the Technology Competitiveness Council (TCC), or otherwise as chair of an interagency task force, to oversee this effort. The executive order should direct the Secretary of Commerce—in coordination with the Under Secretary of Commerce for Intellectual Property and the Director of the USPTO²⁷—to develop proposals to reform and establish new IP policies and regimes, as needed, to incentivize, expand, and protect AI and emerging technologies. The plan should include proposals for executive and legislative actions for IP policy changes to achieve these objectives and should be accompanied by an assessment of a non-exhaustive list of “IP considerations.”²⁸ The Executive Order should direct the Vice President to assess which IP policies, regimes, and reform proposals from the Secretary of Commerce should be integrated into national security, economic, and technology competitiveness strategies and empower the Secretary of Commerce to facilitate implementation of such proposals.

National Intellectual
Property
Considerations.

Patent Eligibility



Combat IP Theft



Counter China's Narrative on "Winning" Tech Competition Based on Filings



Inventorship by AI



Impact of China's Filings on USPTO & U.S. Inventors



Global IP Alignment Efforts



Impediments to AI Public-Private Partnerships & International Collaboration



Democratize Innovation & IP Ecosystems



IP Protection for Data



"Standard-Essential" Patents Process

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¹ Advances in emerging technologies require significant investments. These investments are partly public, but advances also require extensive private investments.

² Technologies critical to national security interests include AI and biotechnology. NSCAI proposes an initial list of emerging technologies key to U.S. national competitiveness in Chapter 16 of this report.

³ CSET translation of *National 13th Five-Year Plan for the Development of Strategic Emerging Industries*, Central People's Government of the People's Republic of China at 59 (Nov. 29, 2016) (translation by CSET on Dec. 9, 2019), <https://cset.georgetown.edu/research/national-13th-five-year-plan-for-the-development-of-strategic-emerging-industries/>. China continues to make extensive reforms to its IP regimes in furtherance of its innovation and industrial competitiveness goals. See Mark Cohen, *IPO's Comments on Recent Patent Legislation: Untangling a Complex Web*, China IPR blog (Dec. 15, 2020), <https://chinaipr.com/2020/12/15/ipos-comments-on-recent-patent-legislation-untangling-a-complex-web/>.

⁴ China's actions include ensuring that AI and associated technologies are eligible for patent protection, increasing damages awards for patent infringement, continuing to issue preliminary injunctions for infringement of valid patents, and creating specialized IP courts with more efficient resolution of IP cases. See Kevin Madigan & Adam Mossoff, *Turning Gold into Lead: How Patent Eligibility Doctrine Is Undermining U.S. Leadership in Innovation*, *George Mason Law Review* at 943-946 (April 13, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2943431 [hereinafter *Turning Gold Into Lead*]; Ryan Davis, *4 Things to Know About China's Revised Patent Law*, *Law 360* (Nov. 5, 2020), <https://www.law360.com/articles/1326419/>; Liaoteng Wang et. al., *A Comparative Look at Patent Subject Matter Eligibility Standards: China Versus the United States*, *IP Watchdog* (June 12, 2020), <https://www.ipwatchdog.com/2020/06/12/comparative-look-patent-subject-matter-eligibility-standards-china-versus-united-states/id=122339/>; Erick Robinson, *Everything You Need to Know about China's New Preliminary Injunction Rules*, *IAM* (Dec. 21, 2018), <https://www.iam-media.com/designs/everything-you-need-know-about-chinas-new-preliminary-injunction-rules>; Justice Tao Kaiyuan, *China's Commitment to Strengthening IP Judicial Protection and Creating a Bright Future for IP Rights*, *World Intellectual Property Organization*, *WIPO Magazine* (June 2019), https://www.wipo.int/wipo_magazine/en/2019/03/article_0004.html.

⁵ See *Turning Gold Into Lead*, at 955.

⁶ See *Turning Gold Into Lead*. In January 2019, the United States Patent & Trademark Office (USPTO) published initial patent eligibility guidance that applies during examination of patent applications at the USPTO, which arguably decreased uncertainty as to patent eligibility determinations during the patent application examination and granting process. However, the United States Court of Appeals for the Federal Circuit, the appellate court with jurisdiction of appeals from patent cases, held that it is not bound by the Guidance. See *Cleveland Clinic Found. v. True Health Diagnostics LLC*, 760 F. App'x at 1013, 1020 (Fed. Cir. 2019) (non-precedential); *In re Rudy*, 956 F.3d 1379, 1383 (Fed. Cir. 2020) (precedential) (citing *Cleveland Clinic Found.*, 760 F. App'x at 1021).

⁷ *Athena Diagnostics v. Mayo Collaborative Services*, 915 F.3d 743 (Fed. Cir. 2019), rehearing en banc denied 927 F.3d 1333 (Fed. Cir. 2019) (method of diagnosing certain, previously undiagnosable, patients suffering from the neurological disorder myasthenia gravis using MuSK autoantibodies); *The Cleveland Clinic Found. v. True Health Diagnostics LLC*, 760 F. App'x 1013 (Fed. Cir. 2019) (method of assessing the risk a patient has cardiovascular disease by analyzing the level of a certain enzyme in a patient's blood); *Roche Molecular Systems, Inc. v. Cepheid*, 905 F.3d 1363 (Fed. Cir. 2018) (DNA primers used in a method to detect the pathogenic bacterium *Mycobacterium tuberculosis*); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371 (Fed. Cir. 2015), *cert. denied*, 136 S. Ct. 2511 (2016) (method of diagnosing fetal characteristics based on paternally inherited DNA found in a mother's bloodstream without creating a major health risk for the fetus); *PUREPREDICTIVE, Inc. v. H2O.AI, Inc.*, No. 17-cv-03049-WHO, 2017 WL 3721480 (N.D. Cal. Aug. 29, 2017) (predictive analytics); *Power Analytics Corp. v. Operation Tech., Inc.*, No. 16-cv-01955 JAK (FFMx), 2017 WL 5468179 (C.D. Cal. July 13, 2017) ("computer simulation techniques with real-time system monitoring and prediction of electrical system performance").

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⁸ See *Crash Course on Patents: What Is a Patent and Why Is It Useful*, Ius Mentis (last accessed Dec. 30, 2020), <https://www.iusmentis.com/patents/crashcourse/whatis/> (because patents openly publish details of the invention, other inventors can license this invention or think of enhancements or design around the disclosure); Steven Hoffman & Calla Simeone, *Trade Secret Protection & the COVID-19 Cure: Observations on Federal Policy-Making & Potential Impact on Biomedical Advances*, JDSupra (Sept. 15, 2020), <https://www.jdsupra.com/legalnews/trade-secret-protection-the-covid-19-37383/> (discussing implications of uncertainty in patent eligibility on use of trade secrets for biomedical advances).

⁹ Surveys and industry reports demonstrate that investment has already shifted away from patent-intensive industries. See Mark F. Schultz, *The Importance of an Effective and Reliable Patent System to Investment in Critical Technologies*, Alliance for U.S. Startups and Investors for Jobs at 24-37 (July 2020), https://static1.squarespace.com/static/5746149f86db43995675b6bb/t/5f2829980ddf0c536e7132a4/1596467617939/USIJ+Full+Report_Final_2020.pdf.

¹⁰ Patrick Thomas & Dewey Murdick, *Patents and Artificial Intelligence: A Primer*, Center for Security and Emerging Technology at 10 (Sept. 2020), <https://cset.georgetown.edu/wp-content/uploads/CSET-Patents-and-Artificial-Intelligence.pdf> [hereinafter CSET, A Primer]; *U.S. Patent Statistics Chart Calendar Years 1963-2019*, USPTO (April 2020), https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm.

¹¹ See CSET, A Primer at 11; Aaron Winger, *China Surpasses U.S. to Become Top Filer of PCT International Patent Applications in 2019*, National Law Review (April 7, 2020), <https://www.natlawreview.com/article/china-surpasses-us-to-become-top-filer-pct-international-patent-applications-2019>. China is on pace to continue being the top PCT filer in 2020. See Aaron Winger, *China 2020 H1 Patent Data Indicates China Likely to Remain Top International Filer in 2020*, National Law Review (July 11, 2020), <https://www.natlawreview.com/article/china-2020-h1-patent-data-indicates-china-likely-to-remain-top-international-filer>.

¹² *AI Innovators*, RS (last accessed Dec. 30, 2020), <https://uk.rs-online.com/web/generalDisplay.html?id=did-you-know/ai-innovators>; George Leopold, *China Dominates AI Patent Filings*, Enterprise AI (Aug. 31, 2020), <https://www.enterpriseai.news/2020/08/31/china-dominates-ai-patent-filings/>; CSET, A Primer.

¹³ CSET, A Primer at 9, 12, n. 23.

¹⁴ *Trademarks and Patents in China: The Impact of Non-Market Factors on Filing Trends and IP Systems*, USPTO at 1 (Jan. 2021), <https://www.uspto.gov/sites/default/files/documents/USPTO-TrademarkPatentsInChina.pdf>; Jonathan Putnam, et al., *Innovative Output in China*, SSRN at 32 (Aug. 2020) (pending revision), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3760816.

¹⁵ Jeanne Suchodolski, et al., *Innovation Warfare*, North Carolina Journal of Law & Technology at 201 (Dec. 7, 2020), <https://ncjolt.org/articles/volume-22/volume-22-issue-2/innovation-warfare/> [hereinafter *Innovation Warfare*].

¹⁶ Rob Sterne, *How China Will Fundamentally Change the Global IP System*, IP Watchdog (July 24, 2019), <https://www.ipwatchdog.com/2019/07/24/china-changing-global-ip-system/id=111613/>.

¹⁷ Over-declaration is already present in 5G. See Matthew Noble, et al., *Determining Which Companies Are Leading the 5G Race*, IAM (July/August 2019), <https://www.twobirds.com/~media/pdfs/news/articles/2019/determining-which-companies-are-leading-the-5g-race.pdf?la=en&hash=8ABA5A7173EEE8FFA612E070C0EA4B4F53CC50DE>; *Meeting the China Challenge: A New American Strategy for Technology Competition*, Working Group on Science and Technology in U.S.-China Relations at 27, 29 (Nov. 16, 2020), https://china.ucsd.edu/files/meeting-the-china-challenge_2020_report.pdf [hereinafter *Meeting the China Challenge*].

¹⁸ *IEEE SA Standards Board Bylaws*, IEEE Standards Association (last accessed Jan. 15, 2020), <https://standards.ieee.org/about/policies/bylaws/sect6-7.html#loa>.

¹⁹ *5G Technological Leadership*, Hudson Institute (Dec. 5, 2020), <https://www.hudson.org/research/16547-5-g-technological-leadership>; *Innovation Warfare*, at 201, n.130 (China's firms recognize the strategic importance of standard-setting activities and that participation in those forums provides the legal means to both access and influence developing technologies).

²⁰ Because standard-essential patents (SEPs) may reach into the hundreds of thousands for technologies, licensing fees carry significant economic repercussions. See *5G Technological Leadership*, Hudson Institute at 3 (Dec. 5, 2020), <https://www.hudson.org/research/16547-5-g-technological-leadership> (“[P]atent counting might have negative consequences on firms working in the US innovation economy ... if judges or regulators rely on simple counts of total patents as a metric for determining the value of patent portfolios. The failure to account for differences in patent quality risks overcompensating some patent holders, namely those with less valuable technologies, but undercompensating those that have developed breakthrough innovation.”); Andrei Iancu, Director of USPTO, Remarks at the Center for The Protection of Intellectual Property 2020 Fall Conference (Oct. 7, 2020), <https://cpip.gmu.edu/2020/10/20/cpip-2020-fall-conference-day-one-recap/>; Muzammil Hassan, et al., *Who Owns Core 5G Patents? A Detailed Analysis of 5G SEPs*, GreyB (2020), <https://www.greyb.com/5g-patents/#The-State-of-Declared-5G-Patents>; Cody M. Akins, *Overdeclaration of Standard-Essential Patents*, Texas Law Review (2020), https://texaslawreview.org/wp-content/uploads/2020/02/Akins_Printer.pdf.

²¹ Mitchell Smith, *A Comparison of the Legal Protection of Databases in the United States and EU: Implications for Scientific Research*, SSRN (May 23, 2010), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1613451; Daniel J. Gervais, *Exploring the Interfaces Between Big Data and Intellectual Property Law*, *Journal of Intellectual Property, Information Technology and Electronic Commerce Law* (2019), <https://scholarship.law.vanderbilt.edu/faculty-publications/1095>.

²² In the USPTO report surveying stakeholders for perspectives on IP policy for AI, “[c]ommenters were nearly equally divided between the view that new intellectual property rights were necessary to address AI inventions and the belief that the current U.S. IP framework was adequate to address AI inventions. Generally, however, commenters who did not see the need for new forms of IP rights suggested that developments in AI technology should be monitored to ensure needs were keeping pace with AI technology developments. The majority of opinions requesting new IP rights focused on the need to protect the data associated with AI, particularly ML.” *Public Views on Artificial Intelligence and Intellectual Property Policy*, USPTO at 15 (Oct. 2020), https://www.uspto.gov/sites/default/files/documents/USPTO_AI-Report_2020-10-07.pdf.

²³ Thomas E. Ayers, *Changing How We Buy Weapons Will Benefit Industry, Government and Taxpayers*, *Defense News* (Nov. 20, 2019), <https://www.defensenews.com/opinion/commentary/2019/11/20/changing-how-we-buy-weapons-will-benefit-industry-government-and-taxpayers/> (discussing the tension between Air Force and vendors over IP protection).

²⁴ See also the Chapter 15 Blueprint for Action.

²⁵ Meeting the China Challenge, at 4, 16.

²⁶ *Annual Intellectual Property Report to Congress*, U.S. Intellectual Property Enforcement Coordinator (March 2020), <https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/04/IPEC-2019-Annual-Intellectual-Property-Report.pdf> (providing an overview of IP responsibilities across the United States government).

²⁷ Other Executive Branch departments and agencies, and the U.S. Copyright Office, should resource and support the Secretary of Commerce in these efforts.

²⁸ A non-exhaustive list of IP considerations should include patent eligibility doctrine, countering China's narrative on “winning” AI innovation based on patent application filings, the impact of China's patent application filings on USPTO's examination process and U.S. inventors, impediments in IP contractual system to public-private partnerships and international collaboration, IP protections for data, combatting IP theft, AI inventorship, global IP alignment, democratizing innovation and IP ecosystems, and SEPs process.