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THE ROLE OF KNOWLEDGE DEMAND IN INNOVATION SYSTEMS: EVIDENCE FROM JAPAN`S STATE-INDUSTRY COORDINATION * +

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Contemporary studies on Japanese science and technology (S&T) policy predominantly examine the constraints of intersectoral initiatives in overcoming the country's developmental stagnation. The distinctive institutional and policy features of its public-private sector symbiosis are thereafter overlooked, depriving policy makers of critical insights into demand-side governance mechanisms through policy instruments and coordination frameworks.

This paper examines all Science and Technology Basic Plans (1996–2025) to assess the main causes and purpose behind the gradual institutionalization of public-private coordination and their changing focus from sectoral to social and national development. To assess their reach and effectivity, the tasks, policy measures and outcomes documented in available annual Integrated Innovation Strategies from (2016–2024) are compared. Regarding intersectoral priority directions, four main episodes are noted: strengthening of structural linkages (within the government-university-corporation framework) (2016 to 2017), societal transformation (2018), crisis response (2019–2020) and strategic autonomy (2021–2024). A typology of measures is constructed by their frequency, the most prevalent being joint public-private R&D, fiscal incentives for corporate innovation and technology transfer regulations.

Is concluded that Japan's state and corporate-led intervention effectively influences private R&D investment, particularly in mission-critical areas, however the scope of its technological policies are constrained by the capacity of key stakeholders to increase their knowledge demand in a short term. As a result, Japanese S&T policy has embraced short-term, challenge-driven interventions with more tangible goals, however have so far failed to overcome regulatory bottlenecks, uneven SME participation, and persistent human capital shortages that constrain the nation's overall innovation scalability.

Based on the tasks and challenges stated in both, Basic Plans and Integrated Innovation Strategies, this study provides policy recommendations within the framework of dynamic regulatory sandboxes, SME-targeted fiscal instruments, and workforce upskilling reforms to enhance systemic resilience.

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РОЛЬ СПРОСА НА ЗНАНИЯ В ИННОВАЦИОННЫХ СИСТЕМАХ: ДАННЫЕ О КООРДИНАЦИИ ГОСУДАРСТВА И ПРОМЫШЛЕННОСТИ В ЯПОНИИ

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Современные исследования научно-технологической политики Японии преимущественно фокусируются на анализе ограничений межсекторальных инициатив в контексте преодоления стагнации национального развития. При этом уникальные институциональные характеристики и политические особенности модели государственно-частного партнерства остаются недостаточно изученными, что лишает политических акторов важной информации относительно механизмов управления со стороны спроса, реализуемых посредством инструментов политики и координационных структур.

В настоящем исследовании проводится комплексный анализ всех Базовых планов развития науки и технологий (1996–2025) страны с целью выявления ключевых факторов и целевых установок постепенной институционализации государственно-частной координации, а также эволюции ее фокуса с отраслевого на социальное и национальное развитие. Для оценки масштаба и эффективности реализации указанных планов осуществляется сравнительный анализ задач, мер политики и достигнутых результатов, зафиксированных в ежегодных стратегиях комплексного инновационного развития (2016–2024). В ходе исследования выделены четыре последовательных этапа эволюции приоритетов межсекторального взаимодействия: период укрепления структурных взаимосвязей в треугольнике «государство–университеты–бизнес» (2016–2017), этап социальной трансформации (2018), фаза антикризисного регулирования (2019–2020) и современный этап обеспечения стратегической автономии (2021–2024). Методом частотного анализа сформирована типология наиболее распространенных инструментов политики, среди которых доминирующее положение занимают механизмы поддержки совместных исследований и разработок организациями государственного и частного секторов, система фискальных стимулов для инновационного развития бизнеса, а также нормативно-правовые акты, регулирующие процессы трансфера технологий.

Проведенный анализ позволяет сделать вывод, что в Японии государственное регулирование в партнерстве с корпоративным сектором действительно оказывает значимое влияние на объем частных инвестиций в исследования и разработки, особенно в стратегически важных отраслях экономики. Однако эффективность проводимой технологической политики существенно ограничена институциональными барьерами, прежде всего неспособностью ключевых участников инновационного процесса оперативно наращивать спрос на новые знания и технологические решения. Это институциональное ограничение привело к переориентации научно-технической политики страны на краткосрочные целевые интервенции, сфокусированные на решении конкретных технологических вызовов и имеющие четкие количественные показатели результативности. Однако, как показывает исследование, подобные меры пока не позволяют преодолеть системные ограничения инновационного развития, включая сохраняющиеся регуляторные барьеры, неравномерное участие малого и среднего бизнеса в инновационных процессах, а также хронический дефицит квалифицированных кадров необходимой специализации. Совокупное действие этих факторов продолжает сдерживать возможности масштабирования инноваций на уровне экономики в целом.

На основании анализа задач и вызовов, сформулированных как в Базовых планах, так и в Комплексных инновационных стратегиях, в рамках настоящего исследования предлагаются рекомендации по совершенствованию политики в следующих ключевых направлениях: внедрение динамичных регуляторных «песочниц», разработка целевых фискальных механизмов для субъектов малого и среднего предпринимательства, а также реализация реформ в области повышения квалификации рабочей силы. Предлагаемый комплекс мер направлен на усиление устойчивости национальной инновационной системы.

Ключевые слова: Япония, спрос на знания, инновационная политика, научно-техническая политика, миссия-ориентированная политика, государственно- и рыночно-ориентированные инновации, государственно-частное партнерство, исследования и разработки

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Introduction

This research builds on the author's hypothesis that innovation is driven by a dynamic equilibrium between the supply of accumulated industrial capabilities and the continuous demand for state and industry knowledge.

Japan represents an important case study for examining this proposition, as it demonstrates a distinct developmental trajectory among state-led late-industrializing nations. Superficially, Japan exhibits conceptual similarities with other East Asian economies, particularly in its adoption of Western education systems, post-war technological investments for industrial recovery, and subsequent focus on high-tech industries to enhance global competitiveness. However, Japan distinguishes itself through the unprecedented scale and diversification of its economy, driven by sustained intersectoral coordination since the onset of its late industrialization.

For instance, the Meiji Restoration (1868–1912) marked the institutionalization of a centralized, state-directed scientific and industrial framework, beginning with the founding of Japan's first Western-style universities, (such as Tokyo Imperial University in 1877), which housed STEM departments initially staffed by foreign experts under government-sponsored programs [Curtis, 1996, p. 269–272]. These early partnerships yielded substantial technological spillover effects while cementing enduring collaborations between state-aligned corporations and academic institutions through formal contractual agreements. Over time, these institutional arrangements laid the foundation for Japan's modern industrial conglomerates.

The post-World War II era brought substantial restructuring of Japan's governance apparatus under US occupation, marked by significant expansions in higher education access through the School Education Law of 1947[2], particularly in STEM fields. This period also saw the implementation of knowledge transfer programs like the Productivity Program of 1955, which facilitated exchanges of managers, engineers, and scientists with US companies, along with strategic technology licensing arrangements. These developments fundamentally transformed government-industry relations, enhancing private sector negotiating power through business federations while establishing new frameworks for public-private partnerships in capital-intensive domains such as space exploration and nuclear energy [Yamada, 1956, p. 33–45]. The creation of institutions like the Japan Society for the Promotion of Science (1949) and

[2] Gakkō kyōiku-hō [School Education Law] // National Diet, 1947. URL: https://laws.e-gov.go.jp/law/322AC0000000026 (accessed: 01.04.2026).

the Ministry of International Trade and Industry (1949) further institutionalized state support for industrial research and talent development.

Subsequent decades witnessed intensive export-oriented industrialization efforts characterized by state support for private sector development and manufacturing capabilities in high-value commercial sectors (including electronics and automotive industries), demonstrating a synergistic alignment of business and public interests focused on sustained economic growth. However, the financial crisis of the early 1990s marked a turning point, prompting the state to adopt a more active role in stimulating knowledge demand to address systemic economic and demographic challenges through targeted science and technology coordination mechanisms [Odagiri, 1997, pp. 461–471].

This historical overview reveals that while Japan's science and technology policy (STI) shares foundational characteristics with other developed nations, it has evolved into a sophisticated state management instrument and national agenda facilitator in the 21st century. Important questions remain however regarding the formal processes governing public-private sector interactions, particularly in determining knowledge demand priorities when addressing national and social challenges, as well as assessing the overall effectiveness of these mechanisms in promoting national development.

From Fragmentation to Integration: The Evolution of Japan's Science and Technology Governance

The evolution of Japan's science and technology governance framework emerged against a backdrop of intense global competition and prolonged domestic economic stagnation following the collapse of the asset price bubble. During this critical period, the nation's support measures for scientific and technological advancement remained fragmented across various government agencies, lacking coherent institutional objectives and effective coordination mechanisms. The pivotal turning point came with the enactment of the Basic Science and Technology Law in 1995,[3] which established a structured framework for science and technology policy through five-year "Basic Plans" developed under the auspices of the Council for Science and Technology, operating under the Prime Minister's authority. However, the Council initially functioned primarily in an advisory capacity, lacking sufficient mechanisms to resolve inter-ministerial conflicts, particularly between the industry-focused METI (Ministry of Economy, Trade and Industry) and academia-oriented MEXT (Ministry of Education, Culture, Sports, Science and Technology), or to effectively align industrial priorities with national strategic objectives.

The implementation of the Central Government Reform Act between 1998 and 2001[4] marked a significant transformation in Japan's science and technology governance architecture. This legislative reform strengthened the Prime Minister's executive authority within the Cabinet Office and elevated the status of the reorganized Council for Science and Technology Policy, consolidating its position as Japan's preeminent science and technology policymaking body. The Council's expanded mandate encompassed the formulation of national objectives within the Basic Plans framework, coordination of comprehensive research and development programs involving public-private-academic collaboration, allocation of budgetary resources to relevant ministries and agencies, and the proposal of legislative and regulatory measures for priority domains including artificial intelligence, digital transformation, and economic security.

[3] Kagaku gijutsu inobēshon kihon-hō kagaku gijutsu inobēshon sōshutsu no kassei-ka ni kansuru hōritsu [Basic Act on Science, Technology and Innovation / Act on Revitalization of Science, Technology and Innovation Creation] // National Diet, 1995. URL: https://www8.cao.go.jp/cstp/cst/kihonhou/mokuji.html (accessed: 01.04.2026).

[4] Central Government Reform of Japan // Prime Minister's Office, 2001. URL: https://japan.kantei.go.jp/central_government/frame.html (accessed: 01.04.2026).

The composition of the Council for Science and Technology Policy reflects Japan's institutionalized approach to integrating diverse stakeholder interests, comprising government ministers, industry leaders (typically chief executives of major corporations), university presidents, and distinguished scientists appointed by the Prime Minister to facilitate the consolidation of cross-sectoral interests while maintaining dedicated implementation mechanisms. Japan's five-year Basic Plans exhibit certain characteristics reminiscent of centrally-planned economic systems, particularly in their establishment of budgetary targets and inter-institutional roadmaps for addressing national challenges, notwithstanding, Japan's model remains distinctive in its ability to harmonize private sector interests through a network of highly diversified corporations that occupy strategic positions within the national economic landscape without resorting to direct government control.

The effectiveness of interest representation and negotiation between public and private sectors has been significantly affected however by Japan's political dynamics, particularly the frequent turnover of executive leadership. With thirteen different prime ministers serving between 2000 and 2025 (excluding Shinzo Abe's unprecedented eight-year second tenure), the political landscape has been characterized by persistent instability. This pattern of short executive tenures has compounded the inherent challenges of five-year planning cycles, particularly in adapting to unforeseen contextual changes. In response to these limitations, the Council for Science and Technology Policy introduced annual "Integrated Innovation Strategies" in 2016, designed to enhance policy adaptability while establishing concrete timelines for implementation measures that balance state and private sector interests.

Analysis of the evolving objectives within both Basic Plans and Integrated Innovation Strategies reveals distinct phases in Japan's science and technology policy orientation (table 1). The initial four Basic Plans (1996–2015) prioritized the consolidation of Japan's science and technology ecosystem, emphasizing the complementary roles of academic institutions and industrial research and development in enhancing the nation's commercial competitiveness. A significant policy shift occurred with the fifth Basic Plan (2016 onward), which expanded the scope of science and technology policy to address broader socioeconomic challenges through the "Society 5.0" framework articulated in Japan's 2015 Revitalization Strategy. This new paradigm emphasized social equity and quality of life improvements as fundamental components of sustainable growth, representing a departure from previous productivity-centric approaches.

Table 1. Main goals and tasks of Japan's Basic Plans

Document	Goal	Tasks
First Basic Plan (1996–2000)[5]	Transition from industrial policy-driven innovation to a more systematic, long-term investment in science and technology.	1. Shift from industrial and applied R&D to foundational science. 2. Improve PhD programs and training of scientists and engineers to counter the country's brain drain. 3. Reduce bureaucratic processes in funding allocation.
Second Basic Plan (2001–2005)[6]	Strengthen human resource development, strategic prioritization, university-industry collaboration on key areas.	1. Intensive R&D in life sciences, IT and nanotechnologies. 2. Increase support for PhD and postdoc programs as well as international exchanges. 3. Flexible rules for university-industry collaboration.

[5] Kagaku gijutsu kihon keikaku [Basic Plan of Science and Technology] // Ministry of Education, Science, Sports and Culture, 1996. URL: https://www.mext.go.jp/b_menu/shingi/kagaku/kihonkei/honbun.htm (accessed: 01.04.2026).

[6] Dai 2-ki kagaku gijutsu kihon keikaku [Second Science and Technology Basic Plan] // Cabinet Office, 2001. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/honbun.html (accessed: 01.04.2026).

Document	Goal	Tasks
Third Basic Plan (2006–2010)[7]	Strengthen the country's leadership in strategic areas amid global competition challenges.	1. Intensive R&D in life sciences, IT and nanotechnologies. 2. Increased international and university-industry collaboration. 3. Development of S&T regional university and industry clusters with decreasing population density.
Fourth Basic Plan (2011–2015)[8]	Increase the country's disaster resiliency and boost its energy security with emphasis on green technologies.	1. Intensive R&D in life sciences (healthcare), disaster resiliency (environmental, marine, space sectors) and green energy (solar, wind and next generation batteries). 2. S&T to strengthen the national infrastructure. 3. Establish and finance industry-academia R&D in areas of commercial potential.
Fifth Basic Plan (2016–2020)[9]	Lay the foundations for the integration of digital and physical systems within the framework of Society 5.0	1. R&D support for digital technologies as enablers of strategic sectors (energy, healthcare, and manufacturing). 2. Research infrastructure strengthening and attraction of local and foreign talents. 3. Establish and finance industry-academia R&D in advanced technologies for global leadership.
Sixth Basic Plan (2021–2025)[10]	Pursue transformative innovation for sustainable growth (population, industry and economy)	1. Strategic autonomy of key technologies (AI, quantum, semiconductors). 2. Adaptation of digitally integrated technologies to crisis response (post-pandemic reality and geopolitical threats). 3. Foster state-industry-academia with the private sector, including with international partners in key sectors.

Source: Cabinet Office

While the Basic Plans have maintained relatively abstract objectives, the accompanying Integrated Innovation Strategies have demonstrated progressively greater specificity and practical focus (table 2). These annual roadmaps have evolved from initial emphasis on integrating physical and digital infrastructures under the Society 5.0[11] vision to addressing more immediate concerns including economic security, supply chain resilience, and governance frameworks for emerging technologies like artificial intelligence. Considering that the sixth Basic Plan (2021–2025) notably omits explicit references to Society 5.0, potentially reflecting strategic realignments prompted by the COVID-19 pandemic's aftermath and evolving geopolitical tensions affecting science and technology sectors, is worth noting that this shift may however indicate a growing prioritization of short-term, challenge-driven planning over long-term visionary frameworks, with state and industry knowledge demands increasingly shaping national policy directions.

Overview of Japan's Policy Measures for Public-Private Innovation

The measures implemented through Japan's Integrated Innovation Strategies demonstrate distinct characteristics when compared to the more tentative approaches of the Basic Plans, particularly

[7] Dai 3-ki kagaku gijutsu kihon keikaku [Third Science and Technology Basic Plan]. // Cabinet Office, 2001. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/kihon3.html (accessed: 01.04.2026).

[8] Dai 4-ki kagaku gijutsu kihon keikaku [Fourth Science and Technology Basic Plan] // Cabinet Office, 2011. URL: https://www8.cao.go.jp/shougai/suishin/pdf/kihonkeikaku30.pdf (accessed: 01.04.2026).

[9] Dai 5-ki kagaku gijutsu kihon keikaku [Fifth Science and Technology Basic Plan] // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html (accessed: 01.04.2026).

[10] Dai 6-ki kagaku gijutsu kihon keikaku [Sixth Science and Technology Basic Plan] // Cabinet Office, 2021. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/index6.htmlf (accessed: 01.04.2026).

[11] Society 5.0 // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/society5_0/ (accessed: 01.04.2026).

in their capacity to shape both state and corporate knowledge demand (table 2). The evolution of state-led knowledge demand reveals a clear trajectory from addressing broad societal challenges to pursuing targeted geopolitical and technological sovereignty objectives. During the initial implementation period from 2016 to 2018, government priorities centered on mission-oriented research and development in critical sectors such as energy and healthcare, reflecting traditional developmental state models where public institutions identify and pursue complex technological challenges. The emergence of the COVID-19 pandemic in 2020 prompted a shift toward crisis-responsive strategies, with substantial resources allocated to pandemic-related digital health solutions and climate adaptation technologies, particularly hydrogen-based systems. The post-2022 period witnessed further refinement of state priorities toward strategic autonomy, evidenced by significant subsidies directed at securing semiconductor supply chains and developing domestic capabilities in critical materials, highlighting the government's evolving role in mitigating geopolitical risks through science and technology policy.

Table 2. Main goals and measures of Japan's Integrated Innovation Strategies

Document	Goal	Measures
Integrated Innovation Strategy (2016)[12]	Industry-academia R&D alignment	1. Industry-Academia-Government alliances in priority areas; 2. Introduction of mission-oriented R&D for national challenges (e. g., solving energy efficiency, healthcare challenges); 3. Encourage corporate access to public research data; 4. Accelerate technology transfers from universities to firms via technology licensing organizations; promote international joint patents and standardization.
Integrated Innovation Strategy (2017)[13]	Industry-academia R&D alignment	1. Companies co-design national R&D projects; 2. Enhanced R&D Tax Credits: Up to 25% for SMEs, 10% for large companies. 3. Reduced taxes (10–15%) on income from patented technologies; 4. Government acts as a "first adopter" of advanced tech (e. g., robotics in eldercare, renewable energy systems); 5. Creation of regulatory sandboxes.
Integrated Innovation Strategy (2018)[14]	Societal transformation	1. Corporations propose bold R&D goals with social impact; 2. Industry-cross-ministerial R&D programs in autonomous vehicles and energy storage technologies; 3. Enhanced deductions for corporate R&D — up to 30% for SMEs and 15% for large firms in priority areas. 4. Reduced tax rate to 10% for income from patented tech; 5. Government prioritized purchases of AI/robotic solutions.

[12] Kagaku gijutsu inobēshon sōgō senryaku 2016 [Integrated Innovation Strategy 2016] // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/sogosenryaku/2016.html (accessed: 01.04.2026).
[13] Kagaku gijutsu inobēshon sōgō senryaku 2017 [Integrated Innovation Strategy 2017] // Cabinet Office, 2017. URL: https://www8.cao.go.jp/cstp/sogosenryaku/2017.html (accessed: 01.04.2026).
[14] Kagaku gijutsu inobēshon sōgō senryaku 2018 [Integrated Innovation Strategy 2018] // Cabinet Office, 2018. URL: https://www8.cao.go.jp/cstp/tougosenryaku/tougo_honbun.pdf (accessed: 01.04.2026).

Document	Goal	Measures
Integrated Innovation Strategy (2019)[15]	Pandemic response	1. Prioritized R&D in AI, IoT and robotics for disaster resilience and pandemic response; 2. Aligned national R&D budgets with corporate-identified priorities; 3. Expanded cross-sector data sharing between corporations and national research institutes; 4. Expanded state venture-capital funding for university startups; 5. Streamlined patent licensing from public institutes to SMEs and startups.
Integrated Innovation Strategy (2020)[16]	Post-pandemic growth	1. Post-pandemic driven R&D in digital health, telemedicine, and vaccine development through public-private partnerships; 2. Alignment of national AI R&D with industry needs; 3. Shifted R&D focus to renewable energy, hydrogen tech, and circular economies with corporate input; 4. Funding for deep-tech startups; 5. Simplified patent licensing from universities to corporations.
Integrated Innovation Strategy (2021)[17]	Economic security	1. Government-sponsored AI, IoT and 5G to address industry productivity gaps; 2. Aligned corporate R&D with Japan's 2050 carbon-neutral goal; 3. Doubled funding for deep-tech startups (e. g., quantum, biotech) and corporate-startup collaborations; 4. Streamlined university patent licensing; 5. Corporate-state R&D in 6G with global players.
Integrated Innovation Strategy (2022)[18]	Strategic technology governance	1. Aligned corporate R&D in strategic technologies (AI, quantum, and biotech) to reduce foreign dependencies; 2. Subsidies for corporate DX adoption; 3. ¥10 trillion fund for corporate-backed ventures in space, biotech, and AI. 4. Secure cross-border data sharing for firms 5. AI R&D standards and guidelines
Integrated Innovation Strategy (2023)[19]	Industrial chain resiliency	1. Public-private cooperation in securing critical materials; 2. ¥2 Trillion in subsidies for companies in all stages of the semiconductor supply chain; 3. Corporate alliance on carbon neutrality roadmaps; 4. Reduced tax rate to 5% for AI/green-tech IP income; 5. Doubled tax deductions for firm investments in deep-tech startups.

[15] Kagaku gijutsu inobēshon sōgō senryaku 2019 [Integrated Innovation Strategy 2019] // Cabinet Office, 2019. URL: https://www8.cao.go.jp/cstp/togo2019_honbun.pdf (accessed: 01.04.2026).
[16] Kagaku gijutsu inobēshon sōgō senryaku 2020 [Integrated Innovation Strategy 2020] // Cabinet Office, 2020. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2020.html (accessed: 01.04.2026).
[17] Kagaku gijutsu inobēshon sōgō senryaku 2021 [Integrated Innovation Strategy 2021] // Cabinet Office, 2021. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2021.html (accessed: 01.04.2026).
[18] Kagaku gijutsu inobēshon sōgō senryaku 2022 [Integrated Innovation Strategy 2022] // Cabinet Office, 2022. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2022.html (accessed: 01.04.2026).
[19] Kagaku gijutsu inobēshon sōgō senryaku 2023 [Integrated Innovation Strategy 2023] // Cabinet Office, 2023. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2023.html (accessed: 01.04.2026).

Document	Goal	Measures
Integrated Innovation Strategy (2024)[20]	Advanced industrialization	1. 0% tax rate for first 3 years on green-tech IP income; 2. AI-driven bureaucracy; 3. Sandboxes with fast-track approvals for UAVs, space and neuro technologies; 4. ¥20 trillion fund targeting AI, biotech, and space startups; 5. Expanded semiconductor R&D with U.S., Korea, and EU.

Source: Cabinet Office

Private sector knowledge demand within Japan's innovation ecosystem has been shaped through a combination of fiscal incentives, market opportunity structures, and collaborative governance frameworks. For instance, initial policy measures in 2016 focused primarily on research and development tax incentives, offering research and development deductions for large enterprises, alongside mechanisms to streamline technology transfer from academic institutions. Subsequent years saw growing corporate influence on national research and development agendas, manifested through industry-proposed moonshot projects and cross-sector data-sharing initiatives. The period from 2022 to 2024 marked a pronounced shift toward deep technology investments, particularly in artificial intelligence and biotechnology, accompanied by demands for greater regulatory flexibility with the introduction of sandboxes in dedicated sector. This progression illustrates the transformation of private sector engagement from passive policy recipients to active participants in knowledge demand co-creation, facilitated by state-developed risk mitigation instruments including intellectual property tax reductions and venture capital funding mechanisms.

The interface between state and private knowledge demand finds its most sophisticated expression in Japan's hybrid governance model, which strategically combines top-down policy direction with bottom-up innovation dynamics. Corporate involvement in national research and development planning since 2017 exemplifies this co-design approach, enabling firms to reconcile state priorities with market realities. Collaborative initiatives such as public-private pandemic research consortia in 2020 and carbon-neutral industrial alliances in 2023 demonstrate the potential for symbiotic knowledge production, where public funding reduces private sector risk exposure. However, this collaborative framework has not been without tensions, particularly regarding intellectual property control and implementation timelines, where the state's long-term resilience objectives frequently conflicted with corporate return-on-investment expectations. These tensions have been partially resolved through adaptive policy instruments including streamlined patent licensing processes implemented between 2019 and 2024 and experimental regulatory sandbox regimes established in 2024, which collectively attempt to balance proprietary interests with collective innovation goals.

Japan's fiscal and regulatory toolkit for modulating knowledge demand has undergone significant refinement since 2016. For instance, early tax incentive structures rewarded private sector research and development investment but lacked sufficient sectoral specificity, by 2021 however, these incentives became more targeted, offering differential deduction rates such as 30% for small and medium enterprises operating in priority areas, reflecting deliberate state steering toward strategic technologies including artificial intelligence and green energy solutions. The 2023–2024 reforms introduced further sophistication through tiered intellectual property tax rates, including preferential 5% rates for artificial intelligence and green technologies and complete tax exemptions for the first three years of operation, creating explicit linkages between private sector returns and national strategic objectives. Parallel developments in regulatory frameworks, particularly the expansion of sandbox mechanisms between 2017 and 2024, have reduced

[20] Kagaku gijutsu inobēshon sōgō senryaku 2024 [Integrated Innovation Strategy 2024] // Cabinet Office, 2024. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2024.html (accessed: 01.04.2026).

barriers to innovation in high-risk sectors including drone technologies and space commercialization, enabling controlled experimentation environments. These policy instruments collectively demonstrate a comprehensive state strategy to internalize innovation externalities, using public subsidies and tax policy to redirect private knowledge demand toward socially optimal outcomes including decarbonization and supply chain resilience.

Japan's science and technology system presents a compelling challenge to conventional linear innovation models by demonstrating the iterative interaction between state and private knowledge demand. The system exemplifies how corporate input can reshape national research and development budgets, as evidenced in 2019, while state responses to crises such as pandemics and climate emergencies can redirect private sector research priorities. This dynamic aligns with Mazzucato's (2013) [Mazzucato, 2013, pp. 97–103] entrepreneurial state thesis, which posits that public institutions not only address market failures but actively create new markets through mechanisms such as first-adopter procurement policies. Three particularly noteworthy features emerge from this analysis: dynamic fiscal instruments including time-bound intellectual property tax cuts that synchronize state and private sector priorities; co-governance mechanisms such as regulatory sandboxes that mediate differences in risk tolerance; and strategic global alliances in areas like semiconductor development that reconcile national autonomy with international interdependence. These elements collectively represent Japan's distinctive approach to orchestrating innovation through the strategic management of knowledge demand.

From Basic Plans to Integrated Strategies: Measuring Japan's Innovation Policy Outcomes

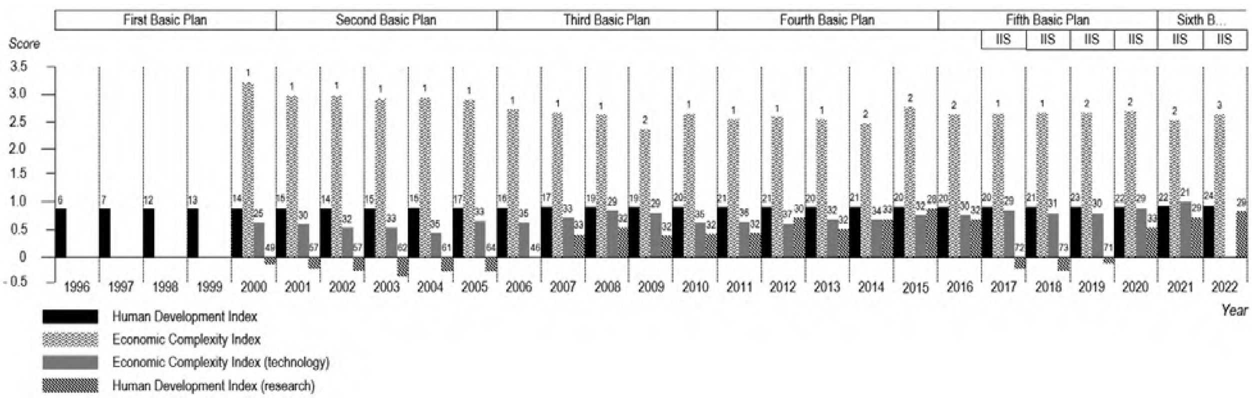
The assessment of Basic Plan effectiveness reveals mixed outcomes when evaluated against research and development expenditure targets, with only the Basic Plan (2001–2005) achieving its stated financial objective of 3% (from 2.9%) (table 3).

Table 3. Main performance indicators of Japan's Basic Plans from 1996 to 2022

Document	Target goal,%	Actual expenditure,%	Document	Target goal,%	Actual expenditure,%
First Basic Plan (1996–2000)	3	2.6 (1996); 2.8 (2000)	Fourth Basic Plan (2011–2015)	3.5	3.2 (2011); 3.2 (2015)
Second Basic Plan (2001–2005)	3	2.9 (2001); 3.1 (2015)	Fifth Basic Plan (2016–2020)	4	3.1 (2016); 3.3 (2020)
Third Basic Plan (2006–2010)	3.5	3.2 (2006); 3.1 (2010)	Sixth Basic Plan (2021–2025)	4	3.3 (2021); 3.4 (2022)

Source: Cabinet Office

A more comprehensive evaluation incorporating socioeconomic indicators shows however modest progress, as evidenced by the Human Development Index improvement from 0.874 in 1996 to 0.920 in 2022, though this was accompanied by a relative decline in global ranking from 6th to 24th position. Technological impact measurements using the Economic Complexity Index present a more favorable picture, with Japan maintaining consistent global leadership despite temporary setbacks in 2009, 2014–2016, and 2019–2023. The observed volatility in technology and research complexity metrics between 2000–2007, 2008–2012, and post-2013 corresponds with major policy realignments, particularly following the 2013 Comprehensive Strategy on Science, Technology, and Innovation which laid the groundwork for subsequent Integrated Innovation Strategies (table 3).



Graph 1: Japan's main development indicators and global position.
Source: United Nations Development Programme. Human Development Index by country // United Nations Development Programme, 2026. URL: https://hdr.undp.org/data-center/country-insights#/ranks (accessed 01.04.2026); Atlas Economic Complexity ranking by country // Atlas of Economic Complexity, 2026. URL: https://atlas.hks.harvard.edu/rankings (accessed: 01.04.2026)

The evaluation framework for Integrated Innovation Strategies differs substantially from that of Basic Plans, incorporating detailed annual progress assessments and identified implementation challenges that facilitate ongoing policy refinement (table 4). These strategies have demonstrated considerable success in stimulating private sector research and development investment, with corporate expenditure growth accelerating from 6% in 2018 to 30% by 2024, particularly in strategic domains including artificial intelligence, robotics, and sustainable technologies. Japan's achievement of global leadership in hydrogen technology patents, capturing 40% of international filings by 2024, along with consistent top-tier rankings in artificial intelligence and internet-of-things innovations, substantiates the efficacy of its mission-oriented policy approach. These outcomes align with Mazzucato's conceptual framework of entrepreneurial state intervention, particularly in demonstrating how targeted public support can catalyze technological leadership in strategically important sectors.

Table 4. Main outcomes and challenges of Japan's Integrated Innovation Strategies

Document	Previous year outcomes	Challenges
Integrated Innovation Strategy 2017	–	1. Slow Tech Transfer: University patents often remained unexploited; 2. Fragmented Governance: Multiple ministries (METI, MEXT) overlapped on innovation policies.
Integrated Innovation Strategy 2018	1. Corporate R&D investment rose 6% YoY in AI/robotics; 2. Japan ranked 3rd globally in IoT patent filings (2018).	1. Slow adoption of open data by traditional industries; 2. Regulatory bottlenecks in sandbox approvals.
Integrated Innovation Strategy 2019	1. Corporate R&D investment rose 8% YoY in AI/robotics; 2. Japan ranked #1 in IoT patent filings globally (2019).	1. Slow adoption of open data by traditional industries; 2. Regulatory bottlenecks in sandbox approvals.
Integrated Innovation Strategy 2020	1. 10% increase in corporate AI/healthtech R&D investment; 2. Japan ranked #1 in fuel cell patents (2020).	1. Slow SME digital adoption due to legacy systems; 2. Bureaucratic delays in green-tech subsidies.

Document	Previous year outcomes	Challenges
Integrated Innovation Strategy 2021	1. 15% rise in corporate green-tech R&D investment; 2. Japan ranked #2 in global AI patents (2021).	1. Slow SME DX adoption due to legacy systems; 2. Talent shortages in AI/quantum fields.
Integrated Innovation Strategy 2022	1. 20% increase in semiconductor/EV battery R&D investments; 2. Japan ranked #1 in hydrogen patents (2022).	1. Talent gaps in semiconductor engineering; 2. Slow regulatory adaptation for emerging tech.
Integrated Innovation Strategy 2023	1. 25% rise in corporate AI/green-tech R&D investment; 2. Japan ranked #1 in hydrogen/ammonia tech patents.	1. Regulatory lag in AI/commercial space tech; 2. SME adoption gaps in DX/GX initiatives.
Integrated Innovation Strategy 2024	1. 30% increase in corporate AI/quantum R&D spending. 2. Japan leads in hydrogen patents (40% global share).	1. Talent shortages in AI/quantum fields. 2. Regulatory fragmentation in space tech.

Source: Cabinet Office

However, systematic evaluation reveals persistent implementation challenges that have constrained overall policy effectiveness. Technology transfer mechanisms between academic institutions and industry have remained inefficient, with university patent utilization rates consistently below 20% throughout the evaluation period. Regulatory processes have created significant bottlenecks, particularly in the approval of experimental technologies through sandbox mechanisms, where average processing times of 18–24 months have substantially delayed market entry for emerging innovations. These systemic barriers have been particularly detrimental to advanced technology sectors such as artificial intelligence and space technologies, where rapid technological evolution has outpaced regulatory adaptation.

The differential impact of innovation policies across firm size categories presents another significant challenge to equitable knowledge economy development. While large corporations increased research and development investment by nearly 30% in priority areas between 2021–2024, small and medium enterprises demonstrated markedly lower adoption rates for digital and green technologies, remaining below 25% penetration during the same period. This disparity highlights the limitations of generic fiscal incentives in addressing structural barriers that hinder innovation adoption among smaller firms, including constrained organizational capabilities and limited absorptive capacity. The persistent digital divide among small and medium enterprises underscores the need for more tailored policy interventions that account for the heterogeneous needs of different firm categories.

Human capital development emerges as perhaps the most critical constraint on Japan's innovation system performance. Despite achieving global leadership positions in advanced technology domains including artificial intelligence and quantum computing, chronic shortages of skilled professionals have substantially limited growth potential. The projected deficit of 50,000 artificial intelligence specialists by 2025 exemplifies the fundamental misalignment between technological advancement and workforce development trajectories. The persistence of this skills gap across multiple policy cycles suggests that conventional education and training reforms have been insufficient to address deep-seated structural issues in labor market functioning and skills formation systems. This human capital constraint represents a critical bottleneck that threatens to undermine the long-term sustainability of Japan's innovation leadership unless addressed through more comprehensive workforce development strategies.

Conclusions

Japan's innovation trajectory provides compelling evidence that sustained technological advancement necessitates a symbiotic relationship between state-directed knowledge demand and private sector market responsiveness. The institutionalization of the Council for Science and Technology Policy and implementation of Integrated Innovation Strategies have created a framework for dynamically aligning national priorities such as economic security and Society 5.0 objectives with corporate research and development incentives including tax deductions and intellectual property protections. However, this coordination has not been frictionless, with tensions frequently emerging between long-term state objectives like semiconductor sovereignty and industry's short-term profitability requirements. The resolution of these tensions through adaptive policy mechanisms such as regulatory sandboxes and tiered intellectual property tax regimes highlights the critical importance of flexible governance structures in mediating state-market knowledge demand interactions. This case study strongly suggests that innovation systems achieve optimal performance when public and private actors engage in continuous, iterative negotiation rather than operating under either rigid top-down directives or purely laissez-faire market models.

The Japanese experience demonstrates that knowledge demand represents a dynamic rather than static phenomenon, evolving in response to shifting national imperatives. During the post-war reconstruction period, state knowledge demand primarily focused on industrial catch-up through applied research and development in energy and manufacturing sectors, while private sector priorities centered on export-led growth strategies in industries such as electronics and automotive manufacturing. The 2010s witnessed a significant policy transition toward addressing mission-oriented challenges including demographic aging and climate change, subsequently evolving toward concerns of geopolitical resilience in semiconductor supply chains and artificial intelligence governance. This transition became institutionalized through the parallel implementation of five-year Basic Plans and annual Integrated Innovation Strategies, which progressively incorporated private sector expertise into national research and development agendas. The COVID-19 pandemic served as an accelerant for this evolutionary process, driving state knowledge demand toward crisis-responsive initiatives in digital health research while simultaneously encouraging more strategic private sector investment in deep technology development. These findings underscore the necessity for innovation systems to maintain continuous recalibration mechanisms that align knowledge demand with both domestic socioeconomic requirements and global competitive pressures.

While Japan's innovation policies have achieved notable success in stimulating research and development investment, their overall effectiveness has been constrained by persistent structural inefficiencies. Regulatory bottlenecks, particularly in the approval processes for emerging technology sandboxes, have significantly delayed commercialization timelines. Policy impacts have been asymmetrically distributed, for instance large corporations benefiting disproportionately compared to small and medium enterprises amid complex requirements beyond their capabilities, perhaps most critically, however, a chronic human capital shortage has fundamentally constrained innovation scalability. These limitations collectively demonstrate that knowledge demand mechanisms alone prove insufficient without complementary reforms addressing regulatory agility, small and medium enterprise inclusion, and skills development systems. Japan's experience consequently highlights the imperative for holistic innovation ecosystems that simultaneously address funding coordination and systemic implementation barriers.

Japan's innovation system faces significant technology commercialization challenges stemming from protracted regulatory approval processes, particularly in emerging sectors such as artificial intelligence and advanced materials. Addressing these bottlenecks requires implementation of dynamic regulatory frameworks emphasizing iterative adaptation over rigid ex ante controls. Introducing sunset clauses for experimental regulations would ensure temporary measures either expire or renew based on empirical performance metrics, thereby reducing bureaucratic stagnation. Decentralizing compliance certification by delegating approval authority to accredited industry consortia or academic institutions could accelerate time-to-market for priority technologies while maintaining rigorous oversight standards. Integrating artificial intelligence-driven monitoring systems would enable continuous real-time calibration of regulatory thresholds based on policy impact assessments, however legislative amendments to Japan's Basic Science and Technology Law, mandating periodic reviews of regulatory efficacy by the Council for Science and Technology Policy is required.

The persistent under participation of small and medium enterprises in Japan's innovation ecosystem, demands comprehensive recalibration of support mechanisms extending beyond conventional fiscal incentives. Expanding sector-specific innovation vouchers could subsidize small and medium enterprise access to critical research and development infrastructure including high-performance computing clusters and prototyping laboratories, with funding tiers weighted toward priority domains such as renewable energy and advanced manufacturing. Establishing regional digital transformation hubs could provide localized technical assistance, bridging the absorptive capacity gap between small and medium enterprises and larger corporations. Implementing graduated research and development tax credits, offering differential rates for independent small and medium enterprise projects and for public-private collaborations, would incentivize knowledge spillovers while discouraging free-riding behavior. Ensuring accountability would require METI to condition funding on mandatory participation in competency assessments, with underperforming firms redirected to hub-based upskilling programs.

Japan's chronic shortages in high-skilled STEM labor, arise from fundamental misalignments between educational outputs and industry requirements. Addressing this challenge requires implementation of a multipronged human capital development strategy. The establishment of a national upskilling fund, financed through payroll levies on large technology firms matched by government contributions, could subsidize wages for employees undergoing reskilling in critical fields with preferential eligibility for non-STEM mid-career workers. Complementary immigration policy liberalization for specialized technology talent, including fast-track residency pathways for graduates of Japan's leading universities, would help alleviate immediate workforce shortages. However, an effective implementation would necessitate coordinated action by MEXT to revise engineering program accreditation standards and Justice Ministry reforms to streamline visa processing for qualified applicants.

Литература / References

Curtis Terry. Book review of The Technological Transformation of Japan: From the Seventeenth to the Twenty-first Century by Tessa Morris-Suzuki. *Critical Studies in Innovation*. 1996. Vol. 14. Pp. 269–272.

Mazzucato Mariana. The Entrepreneurial State: Debunking Public vs. Private Sector Myths. London: Anthem Press, 2013.

Odagiri Hirojuki. Technology and Industrial Development in Japan: An Evolutionary Perspective. *Journal of Economic Issues.* 1997. Vol. 31. No. 2. Pp. 461–471.

Yamada Ken. On the Five Year Economic Plan in Japan. *The Annals of the Hitotsubashi Academy.* 1956. Vol. 7. No. 1. Pp. 33–45.

Электронные ресурсы / Online resources

Atlas Economic Complexity ranking by country // Atlas of Economic Complexity, 2026. URL: https://atlas.hks.harvard.edu/rankings (accessed: 01.04.2026).

Central Government Reform of Japan // Prime Minister's Office, 2001. URL: https://japan.kantei.go.jp/central_government/frame.html (accessed: 01.04.2026).

Dai 2-ki kagaku gijutsu kihon keikaku [Second Science and Technology Basic Plan] // Cabinet Office, 2001. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/honbun.html (accessed: 01.04.2026).

Dai 3-ki kagaku gijutsu kihon keikaku [Third Science and Technology Basic Plan]. // Cabinet Office, 2001. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/kihon3.html (accessed: 01.04.2026).

Dai 4-ki kagaku gijutsu kihon keikaku [Fourth Science and Technology Basic Plan] // Cabinet Office, 2011. URL: https://www8.cao.go.jp/shougai/suishin/pdf/kihonkeikaku30.pdf (accessed: 01.04.2026).

Dai 5-ki kagaku gijutsu kihon keikaku [Fifth Science and Technology Basic Plan] // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html (accessed: 01.04.2026).

Dai 6-ki kagaku gijutsu kihon keikaku [Sixth Science and Technology Basic Plan] // Cabinet Office, 2021. URL: https://www8.cao.go.jp/cstp/kihonkeikaku/index6.htmlf (accessed: 01.04.2026).

Gakkō kyōiku-hō [School Education Law] // National Diet, 1947. URL: https://laws.e-gov.go.jp/law/322AC0000000026 (accessed: 01.04.2026).

Human Development Index by country // United Nations Development Programme, 2026. URL: https://hdr.undp.org/data-center/country-insights#/ranks (accessed: 01.04.2026).

Kagaku gijutsu inobēshon kihon-hō kagaku gijutsu inobēshon sōshutsu no kassei-ka ni kansuru hōritsu [Basic Act on Science, Technology and Innovation / Act on Revitalization of Science, Technology and Innovation Creation] // National Diet, 1995. URL: https://www8.cao.go.jp/cstp/cst/kihonhou/mokuji.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2016 [Integrated Innovation Strategy 2016] // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/sogosenryaku/2016.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2017 [Integrated Innovation Strategy 2017] // Cabinet Office, 2017. URL: https://www8.cao.go.jp/cstp/sogosenryaku/2017.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2018 [Integrated Innovation Strategy 2018] // Cabinet Office, 2018. URL: https://www8.cao.go.jp/cstp/tougosenryaku/tougo_honbun.pdf (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2019 [Integrated Innovation Strategy 2019] // Cabinet Office, 2019. URL: https://www8.cao.go.jp/cstp/togo2019_honbun.pdf (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2020 [Integrated Innovation Strategy 2020] // Cabinet Office, 2020. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2020.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2021 [Integrated Innovation Strategy 2021] // Cabinet Office, 2021. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2021.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2022 [Integrated Innovation Strategy 2022] // Cabinet Office, 2022. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2022.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2023 [Integrated Innovation Strategy 2023] // Cabinet Office, 2023. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2023.html (accessed: 01.04.2026).

Kagaku gijutsu inobēshon sōgō senryaku 2024 [Integrated Innovation Strategy 2024] // Cabinet Office, 2024. URL: https://www8.cao.go.jp/cstp/tougosenryaku/2024.html (accessed: 01.04.2026).

Kagaku gijutsu kihon keikaku [Basic Plan of Science and Technology] // Ministry of Education, Science, Sports and Culture, 1996. URL: https://www.mext.go.jp/b_menu/shingi/kagaku/kihonkei/honbun.htm (accessed: 01.04.2026).

Society 5.0 // Cabinet Office, 2016. URL: https://www8.cao.go.jp/cstp/society5_0/ (accessed: 01.04.2026).