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Global Science and Innovation Cluster: Tokyo-Yokohama

The Tokyo–Yokohama science and innovation cluster forms the core of Japan's research and innovation system and represents one of the world's largest metropolitan concentrations of scientific and technological activity. Anchored by leading universities, national research institutes, and globally competitive corporate R&D, the cluster plays a decisive role in Japan's scientific output, innovation capacity, and international research engagement.

Since the introduction of the WIPO Global Innovation Index cluster rankings, Tokyo–Yokohama was consistently ranked first globally under the patent- and publication-based methodology. However, with the inclusion of venture capital (VC) activity in the 2025 GII Tokyo–Yokohama was ranked second, reflecting differences in innovation financing structures rather than any decline in the cluster's research or technological performance. The cluster continues to perform at scale in research, patenting, and industrial innovation, while facing structural challenges related to innovation finance, international talent mobility, and system coordination.

This Outlook analyses the Tokyo–Yokohama cluster's research landscape, innovation dynamics, and internationalisation patterns. It provides an evidence-based overview to inform discussion on research cooperation, innovation exchange, and science diplomacy involving Japan and international partners, including Sweden.

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Summary

Tokyo–Yokohama constitutes the backbone of Japan's STI system. Universities, national research institutes, corporate R&D laboratories, and public agencies are densely co-located, making the region the primary arena for national STI policy coordination, priority-setting, and system-level steering – even as organisational boundaries remain strong.

International benchmarking, including WIPO's GII, consistently places Tokyo–Yokohama among the world's leading S&T clusters. While recent methodological changes have affected its formal ranking, the cluster remains a major source of global research and innovation output, underpinned by sustained public and corporate R&D investment.

At the same time, the system faces persistent structural constraints. High metropolitan costs, limited VC activity, and barriers to international talent mobility shape innovation dynamics across the region. Interview insights suggest that, despite its global scale, Tokyo–Yokohama functions less as a rapidly reconfiguring innovation ecosystem than as a mature metropolitan agglomeration; it is resilient and institutionally robust, but slower to adapt to technological and organisational change.

For Sweden, Tokyo–Yokohama represents both a well-established collaboration environment and a strategic opportunity. The region's scientific breadth, industrial depth, and globally significant research institutions offer high-value entry points in areas such as sustainability, advanced materials, digital technologies, and health. Effective engagement, however, requires long-term commitment and carefully structured partnerships with the capacity to navigate the system's complexity at institutional and research group levels.

Why the Cluster Slipped from 1st to 2nd Place

The 2025 GII revision incorporating VC activity altered comparative rankings. Tokyo–Yokohama still leads globally in patenting and publications, but its lower VC intensity relative to Shenzhen–Hong Kong–Guangzhou shifted the combined index. The change reflects structural differences in innovation financing rather than declining performance.

Historic Context

The region's S&T base is not the product of a single coordinated intervention but instead emerged gradually through the long-term co-location of government institutions, research universities, and industrial actors in and around the capital. Japan laid the foundations of its modern industrial and research system from the late 19th century until the Second World War period (1868–1945).[1] Major private-sector firms – including Mitsubishi, Mitsui, and Sumitomo – were founded during this era, alongside utilities and financial institutions with roots in Tokyo and Yokohama.[2] These companies invested heavily in manufacturing and engineering and built in-house laboratories that shaped Japan's distinctive corporate R&D model.[3] Parallel state programmes promoting overseas study and the recruitment of foreign experts contributed to the early formation of Tokyo as Japan's intellectual centre.[4]

Japan's post-war reconstruction and rapid economic growth further consolidated corporate R&D as a central driver of technological advancement.[5] During the 1950s to 1970s, firms such as Hitachi, Sony, Canon, Toshiba, NEC, Fujitsu, and later NTT extended large research facilities across the Tokyo–Yokohama corridor, especially in electronics, telecommunications, automotive technologies, materials, and energy.[3] This industrial expansion was reinforced by the growth of research universities and strong coordination between education and industrial policy.[6]

From the 1970s onward, Japan also experimented with decentralisation.[5] Tsukuba Science City consolidated national research institutes in a planned environment while remaining functionally linked to the capital region.[7] At the same time, bottom-up industrial agglomerations such as the Technology Advanced Metropolitan Area (TAMA) Cluster* emerged, characterised by networks of small and medium-sized manufacturers specialising in advanced production technologies.[8] These developments complemented but did not displace the primacy of the metropolitan core.

Since the 1990s, Tokyo–Yokohama has reasserted its position as Japan's primary S&T hub. The dense concentration of universities, national research institutes, corporate R&D, and government agencies continues to attract research activity, particularly in robotics, digital technologies, life sciences, and emerging high-technology fields.[9,10] This historically layered evolution has produced a multifaceted technological environment that still shapes Japan's current research and innovation landscape.[11,12]

Basic Facts and Research & Innovation Metrics

This section provides a quantitative baseline for assessing Tokyo–Yokohama's global position, benchmarking its research, patenting, and innovation performance while clarifying the effect of recent methodological changes on its formal ranking.

WIPO GII Cluster Methodology and Ranking Dynamics

According to the 2025 GII, Tokyo–Yokohama continues to deliver exceptionally high output despite shifts in ranking methodology.[13] WIPO identifies innovation clusters using three indicators:
– international PCT patent filings
– scientific publications
– VC deal activity (added in 2025)

This bottom-up approach is not bound by administrative borders and spans multiple municipalities. Under the earlier methodology, which only included patents and publications, Tokyo–Yokohama ranked first globally from 2017 to 2024. With the inclusion of VC it slipped to second place behind Shenzhen – Hong Kong – Guangzhou. This shift reflects structural differences in innovation finance and not a decline in research performance – according to WIPO's

*The TAMA cluster spans western Tokyo, southwest Saitama, and central Kanagawa Prefecture along national road Route 16. The TAMA Industrial Activation Association was formally established in April 1998 to foster industry-academic and inter-corporate collaboration, with a particular focus on product-developing SMEs. The cluster is characterised by a concentration of S&T universities, R&D facilities of large enterprises, and small and medium-sized firms with strong product development and market-sensing capabilities.

analysis, Tokyo–Yokohama would still rank first using the pre-2025 metrics.

Table 1. Key metrics (GII 2025). Tokyo–Yokohama's performance in 2025 demonstrates its enduring technological weight.

Metric	
Global scale	
Globally in combined S&T output	2nd
Share of global PCT patent applications	10.3%
Share of global scientific publications	1.4%
Share of global VC deals	2.2%
Globally by population-normalised intensity*	29th
Per-capita averages (per 1 million inhabitants)⁺	
PCT patent applications	3,707
Scientific publications	3,176
VC deals	141

⁺ Per-capita five-year (2021–2025) averages (per 1 million inhabitants)

These indicators highlight the distinction between scale (where Tokyo–Yokohama excels) and intensity (where large populations reduce per-capita ranking).

R&D Expenditure and Industrial Foundations

Japan retains high R&D intensity, with GERD reaching 3.44% of GDP in 2023.[**8,11] Interview evidence linked Tokyo–Yokohama's innovation capacity to production-embedded know-how and robust, sustained corporate R&D investment, which is consistent with Japan's position in the Economic Complexity Index.[14***] Across the metropolitan area, headquarters, system integrators, and dense manufacturing networks form spatial clusters that reinforce the region's central role in national innovation.

VC and Innovation Investment

Japan's VC market remains modest by global standards but has expanded steadily, reaching USD 6.1 billion in 2024, with most activity concentrated in Tokyo. The innovation financing model is structurally hybrid: VC combines with corporate investment, public financial institutions, and policy-linked funding instruments.[15] WIPO emphasises that the inclusion of VC in cluster metrics highlights differences in innovation structure rather than weaknesses in research output.[13]

Field observations – including visits to Tokyo Innovation Base (TIB) and LINK-J[****] – underlined the importance of active ecosystem-building around start-up – corporate interaction, international connectivity, and early-stage scale-up, particularly in deep tech and life sciences. Meanwhile, SusHi Tech Tokyo[*****] functions primarily as a visibility and matchmaking platform.

Scientific Output and Talent Dynamics

Tokyo–Yokohama is one of the world's leading regions for scientific publications, spanning materials science, engineering, life sciences, physics, AI, and robotics.[13,16] However, the sustainability of this output depends increasingly on talent mobility and availability of highly skilled human resources. Japan has historically shown lower inbound and outbound researcher flows, but the region's density and expanding English-language environments are gradually improving connectivity. Interview insights point to persistent shortages of doctoral-level specialists in AI, quantum technologies, biotechnology, and cybersecurity, alongside limited academia – industry mobility and underdeveloped industrial PhD pathways. These constraints affect the region's ability to translate its strong scientific base into sustained leadership.[17,18]

Tokyo–Yokohama's ranking trajectory, 2017–2025	
2017–2024	1st globally (patents + publications)
2025 (new methodology)	2nd globally (patents + publications + VC)
2025 (old methodology)	1st globally

*Scale versus intensity: Tokyo–Yokohama's intensity ranking reflects population size rather than declining output. Interview insights further indicate that important dimensions of Japanese innovation, particularly production-embedded and tacit manufacturing capabilities, are not fully captured by global output-based indicators.

**GERD: for comparison, Sweden's GERD was 3.64% in 2023 (OECD).

***The Economic Complexity Index measures a country's productive knowledge based on the diversity and sophistication of its exports.

****Tokyo Innovation Base (TIB): Tokyo Metropolitan Government's flagship platform for start-up–corporate interaction; LINK-J: Mitsui Fudosa's Life Science Innovation Network Japan.

*****SusHi Tech Tokyo (Sustainable High City Tech Tokyo): major global innovation initiative led by the Tokyo Metropolitan Government.

Sources & Methods

Quantitative benchmarking and qualitative analysis were combined in this examination of the Tokyo–Yokohama science and innovation cluster. Quantitative indicators draw primarily on WIPO's GII, alongside complementary international datasets and publicly available statistics on research activity, innovation performance, and investment. Qualitative analysis is based on desk research of policy documents, institutional reports, and strategic materials, as well as semi-structured interviews with stakeholders from universities, national research institutes, industry, government, funding bodies, and international organisations in Japan and Sweden. Together, these sources provide an integrated view of cluster performance, governance dynamics, and international collaboration patterns.

Glossary

AMED – Japan Agency for Medical Research and Development

AI – Artificial Intelligence

CAGR – Compound Annual Growth Rate

GDP – Gross Domestic Product

GERD – Gross Expenditure on Research and Development

GII – Global Innovation Index

JSPS – Japan Society for the Promotion of Science

JST – Japan Science and Technology Agency

METI – Ministry of Economy, Trade and Industry

MEXT – Ministry of Education, Culture, Sports, Science and Technology

NEDO – New Energy and Industrial Technology Development Organization

OECD – Organisation for Economic Co-operation and Development

PCT – Patent Cooperation Treaty

R&D – Research and Development

R&I – Research and Innovation

RIKEN – Institute of Physical and Chemical Research (Rikagaku Kenkyūsho)

S&T – Science and Technology

STI – Science, Technology, and Innovation

TIB – Tokyo Innovation Base

TMG – Tokyo Metropolitan Government

UTokyo – The University of Tokyo

VC – Venture Capital

WIPO – World Intellectual Property Organization

WPI – World Premier International Research Center Initiative

Origins of the Tokyo–Yokohama Cluster: Spontaneous vs Planned Development

The Tokyo–Yokohama system developed primarily through long-term institutional accumulation, corporate investment, and proximity to national government rather than a single master plan. Research universities, national institutes, and corporate R&D facilities concentrated across the Tokyo–Yokohama–Kawasaki corridor, supporting continuous industry, academia interaction and the emergence of specialised districts. Targeted policy interventions, such as Tsukuba Science City, the TAMA industrial network, and innovation sites in Kanagawa and Yokohama, reinforced the system's decentralised structure without fundamentally altering it.

Tokyo–Yokohama differs from more centrally orchestrated Chinese and Korean systems and shares some characteristics with US ecosystems such as Silicon Valley and Boston–Cambridge, albeit with lower labour mobility and less reliance on VC. Interview insights indicate that while decentralisation contributes to resilience and continuity, it also increases institutional thickness and slow structural adaptation.

Large-scale Research Infrastructure

The region is supported by world-class research infrastructure enabling advanced experimentation and data-intensive science. Key facilities include:

- Photon Factory (PF and PF-AR) at KEK, Tsukuba, a leading synchrotron radiation facility
- The TSUBAME supercomputer at Science Tokyo
- Shared biomedical infrastructure for genomics, imaging, and clinical research

These infrastructures align strongly with Swedish strengths in neutron and synchrotron science, advanced computing, and the life sciences, creating natural entry points for collaboration.

Overview of the Research Landscape

This section examines the structure of Tokyo–Yokohama's research landscape, showing how the institutional density and diversity of Japan's largest S&T ecosystem underpin scientific strength while also producing compartmentalisation and limited cross-sector mobility.

Tokyo–Yokohama's research environment is characterised by high density, plurality, and institutional complexity. It has been shaped by long-established anchor institutions alongside newer coordination mechanisms and large-scale research platforms. The cluster's robustness is therefore accompanied by structural rigidity–a duality that runs through the system's research dynamics.

Universities as Research Anchors

Five universities form the core academic base of the Tokyo–Yokohama cluster:

- The University of Tokyo (UTokyo)
- Institute of Science Tokyo (branded as Science Tokyo; it was established in 2024 via the merger of Tokyo Institute of Technology and Tokyo Medical and Dental University)
- Keio University
- Waseda University
- The University of Tsukuba (functionally integrated into WIPO's cluster definition)

Together, these universities anchor research capacity across complementary fields rather than through a single dominant university. UTokyo serves as the national reference university with major strengths in basic science, engineering, and policy-relevant work; Science Tokyo consolidates leading capabilities in engineering, medicine, and translational science after the merger; Keio and Waseda exemplify research-intensive private university models with strong industry engagement and international collaboration; the University of Tsukuba, though outside the metropolitan core, remains functionally integrated and links planned research capacity with metropolitan concentration.

Collectively, these institutions host internationally recognised research facilities, graduate programmes, and multiple WPI research centres,* acting as major nodes in international research networks. Publication data from WIPO highlight the central role of UTokyo, Science Tokyo, and Keio University in sustaining the cluster's output, reinforcing its breadth and redundancy.

National Research Institutes and Laboratories

Tokyo–Yokohama is functionally integrated with a dense, differentiated, and structurally siloed set of national research institutes supporting long-term, mission-oriented research and large-scale infrastructure. While several of these organisations are located outside the immediate urban core, they are institutionally and operationally embedded in the metropolitan system through governance arrangements, shared facilities, staff mobility, and proximity to national agencies. Key institutes include:

- Rikagaku Kenkyūjo (RIKEN): life sciences (including immunology and brain science), sustainable resource science, and advanced computing, with major campuses in Wako (Saitama) and Yokohama
- National Institute of Advanced Industrial Science and Technology (AIST): industrial technologies, robotics, AI, and materials science
- National Institute for Materials Science (NIMS): advanced materials, nanotechnology, and materials characterisation
- National Cancer Center Research Institute (NCCRI): cancer research, translational medicine, and biomedical science
- National Institute of Information and Communications Technology (NICT): information and communications technologies, including networks, cybersecurity, and AI

* WPI: Established by MEXT in 2007, the WPI programme supports the creation of globally visible, top-level research centres designed to attract leading international researchers and promote interdisciplinary excellence and internationalised research environments. Key features include international competitiveness, interdisciplinarity, as well as English as a working language.[19]

– National Institutes for Quantum Science and Technology (QST): quantum science, fusion energy, and advanced radiation technologies
– National Institutes of Natural Sciences (NINS): inter-university research organisation integrated with the doctoral training programme SOKENDAI, encompassing institutes in astronomy, molecular science, and fundamental biology

These institutes form a stabilising layer that absorbs strategic risk, sustains long-horizon research, and provides shared facilities, reference standards, and national platforms underpinning both academic and industrial innovation.

Institutional Governance and Coordination

This section explains how governance and coordination function within the Tokyo–Yokohama cluster, and why the concentration of national ministries, agencies, and institutions simultaneously enables system-level steering and generates coordination challenges.

As Japan's capital-region S&T hub, Tokyo–Yokohama is the primary locus where national research and innovation policy priorities are articulated, funded, and translated into institutional programmes. Nevertheless, while playing a central coordinating role in Japan's STI system, day-to-day implementation remains distributed across multiple actors in the region.

The cluster operates within a complex, multi-actor governance landscape shaped by overlapping ministerial mandates, funding agencies, and implementation bodies. Core responsibilities are divided among the Cabinet Office (cross-ministerial initiatives), MEXT (universities and basic research), and METI (industrial innovation), supported by major agencies including JST, AMED, NEDO, and JSPS. Together, these actors set research priorities, allocate funding, and oversee implementation across Japan's S&T system.*

This governance structure plays a stabilising and coordinating role at the system level by sustaining long-term, mission-oriented research and ensuring continuity across funding cycles. At the same time, it generates persistent challenges in inter-ministerial coordination and in translating high-level policy objectives into coherent incentives for private-sector innovation. While the coexistence of multiple ministries and agencies contributes to institutional depth, it also increases administrative complexity and coordination costs.

A frequently cited coordinating interface is the Center for Research and Development Strategy (CRDS) within JST, which plays a central role in translating societal challenges into research agendas. CRDS contributes to the design and implementation of major national programmes, including the Moonshot Research and Development Program and the Strategic Innovation Promotion (SIP) programme, both of which seek to align long-term research investment with national priorities. Overall, institutional governance in Tokyo–Yokohama reflects a system designed for stability and long-horizon coordination rather than rapid reconfiguration. While this framework supports resilience and continuity, it also reinforces fragmentation across organisational boundaries and constrains responsiveness to emerging technological opportunities. Metropolitan and platform-level initiatives – such as METI's establishment of an Innovation Bureau in 2024 – aim to mitigate these limitations, but operate within, rather than above, the national governance architecture.

Human Capital, Talent Dynamics, and Corporate R&D Integration

Tokyo–Yokohama concentrates a large share of Japan's research workforce across universities, national institutes, and corporate laboratories, yet faces acute shortages in AI, quantum technologies, biotechnology, and cybersecurity. Limited mobility between academia and industry, together with the fragmented, small-scale nature of industrial PhD and embedded doctoral pathways, constrains skills circulation and limits the development of people-centred translational capacity. Collaboration across universities, public research institutes, and corporate laboratories is particularly strong in robotics, materials, AI, biotechnology, and energy technologies, and is typically aligned with national mission-oriented initiatives including Society 5.0, Green Innovation, and the Moonshot Program.**

Corporate R&D remains a central pillar of the cluster; however, research models are increasingly differentiated. Examples frequently cited by interviewees include globally networked corporate units such as Sony AI and Sony Computer Science Laboratories.***

Overview of the Innovation Landscape

This section analyses Tokyo–Yokohama's innovation landscape, explaining how innovation is shaped less by market dynamics than by historical institutional structures and industrial anchoring and how this affects collaboration and scale-up.

Tokyo–Yokohama brings together Japan's key industrial, academic, and policy actors within a long-established metropolitan innovation system. While universities provide a strong scientific foundation, as previously discussed, innovation dynamics are shaped less by VC intensity than by a

*MEXT: Ministry of Education, Culture, Sports, Science and Technology; responsible for basic research, universities, and research quality. METI: Ministry of Economy, Trade and Industry; oversees industrial R&D and innovation policy. The ministries are supported by major funding and implementation agencies: JST (Japan Science and Technology Agency) AMED (Japan Agency for Medical Research and Development) NEDO (New Energy and Industrial Technology Development Organization), and JSPS (Japan Society for the Promotion of Science).

**National mission-oriented initiatives: Society 5.0: cross-sector vision integrating digital technologies with societal and industrial transformation); Green Innovation: mission-oriented framework supporting long-term corporate-led R&D, demonstration, and industrial transformation toward carbon neutrality; Moonshot Research and Development Program: government-led initiative funding high-risk, high-impact research to address long-term societal challenges.

***Insights from semi-structured interviews with senior researchers at Sony AI CSL.

Benchmark Institution: Okinawa Institute of Science and Technology – Although geographically outside the Tokyo–Yokohama cluster, the Okinawa Institute of Science and Technology (OIST) was frequently mentioned as a benchmark for internationalised research in Japan. Its English-language operating environment, global faculty recruitment, interdisciplinary doctoral education, and strong publication performance distinguish it within the national system. OIST's Tokyo office, established in 2021, supports policy engagement and outreach. OIST functions mainly as a reference point in national debates on institutional autonomy and internationalisation rather than as a component of the Tokyo–Yokohama ecosystem.

While initiatives such as OIST and the WPI programme demonstrate Japan's capacity to create globally oriented research environments, interviewees noted that their impact remains limited by the structural difficulty of scaling pockets of excellence into system-wide change.

dense and historically layered ecosystem. The resulting landscape reflects both a post-war legacy of industrial concentration and a gradual, uneven transition toward greater global collaboration, start-up activity, and international talent engagement.

Industrial Foundations and Corporate R&D

Large industrial actors headquartered in or operating major research centres across the Tokyo–Yokohama corridor are central to the regional innovation system. Firms active in electronics, telecommunications, robotics, materials science, automotive engineering and digital technologies account for a substantial share of Japan's patenting activity and technological sophistication.[13,20] Corporate laboratories remain central to applied innovation research, systems integration, and long-horizon development.

Research on corporate innovation systems highlights historically embedded models characterised by long-term employment, in-house training, and vertically integrated R&D.[21] These arrangements have supported cumulative manufacturing capabilities and the development of tacit production-embedded know-how.[22,23]

However, interviews* indicate growing internal differentiation within corporate R&D structures. Some globally oriented units – such as Sony AI and Computer Science Laboratories (CSL) – recruit internationally trained PhDs, publish extensively, and participate actively in global research networks.[24] Other divisions, on the other hand, prioritise domestic recruitment pipelines and internally coordinated career paths, with less emphasis on academic publication. Such internally coordinated models remain embedded in broader institutional arrangements of employment and skill formation.[25]

This coexistence reflects institutional layering rather than decline. Innovation in Tokyo–Yokohama operates through adaptation within durable organisational structures, producing continuity and depth rather than high entrepreneurial churn. Compared with venture-led ecosystems driven by rapid firm entry and exit, innovation here unfolds at a slower tempo but with sustained industrial anchoring.

Policy Environment and Metropolitan Orchestration

Innovation activity is shaped by national policy frameworks alongside increasingly proactive metropolitan and prefectural initiatives. TMG has frequently been described as an ecosystem orchestrator, linking start-ups, universities, corporations, and international partners through dedicated platforms such as TIB and SusHi Tech Tokyo. These initiatives focus on visibility, matchmaking, and international outreach rather than on system-wide restructuring.[26]

Kanagawa Prefecture complements Tokyo's role through targeted support in healthcare, biotechnology, and green technologies, with Yokohama – the prefecture's largest city – acting as the gateway for international collaboration by hosting multinational firms and globally oriented public – private initiatives.[27]

Unlike Boston – Cambridge, where VC functions as the primary coordination mechanism, or Chinese clusters such as Shenzhen – Guangzhou, where state direction and platform firms exert strong structuring influence, Tokyo–Yokohama is coordinated through anchor institutions. Corporate R&D laboratories, research-intensive universities, national institutes, and metropolitan platforms collectively stabilise innovation activity, thereby privileging continuity and cumulative capability over rapid reconfiguration.

Spatial Innovation Zones and Localised Ecosystems

The Tokyo–Yokohama innovation landscape is polycentric, with specialised districts playing complementary roles rather than converging on a single focal hub. Key nodes include:

*This section draws on semi-structured interviews conducted in Tokyo between February 2025 and February 2026 with researchers affiliated with corporate R&D laboratories in the region, including Sony AI CSL and NTT Basic Research Laboratories.

– Shibuya, as a flagship digital and start-up district with an increasingly international, incubation-orientated culture
– Kawasaki's King SkyFront (Tonomachi), as a life-sciences and environmental innovation hub with a strong gateway function
– Yokohama's Minato Mirai 21, as a centre for biotechnology, pharmaceuticals, AI, and advanced engineering
– The Otemachi–Marunouchi–Nihonbashi corridor, as a focal point for corporate open innovation, including fintech
– The "Hongo Valley" area around UTokyo, where deep-tech start-ups, academic spinouts, and corporate laboratories are increasingly co-locating

While some of these areas consciously adopt global place-branding narratives, most remain emerging or partial ecosystems. Their significance lies less in scale than in their role as experimental interfaces between academia, industry, and policy within an otherwise institutionally anchored system.

Platforms and Ecosystem Intermediaries

Publicly supported platforms, with TIB as the most notable example, are designed to facilitate interaction across sectors and enhance international visibility. These platforms primarily function as convening and matchmaking spaces, supporting early-stage start-ups, corporate engagement, and overseas outreach rather than acting as drivers of firm creation or rapid scaling. Their role is therefore complementary: enabling connectivity within existing institutional structures rather than reshaping the underlying innovation model.

Alongside these public initiatives, a range of private and semi-private intermediaries operates in more specialised domains, performing bridging functions between companies, research organisations, and start-ups. Such intermediaries reduce coordination costs, provide informal governance, and support collaboration in areas characterised by regulatory complexity or long development timelines.*

VC and Private Investment

Tokyo–Yokohama attracts the majority of Japan's VC activity, particularly in AI, robotics, life sciences and biotechnology, enterprise software, and selected fintech segments.[15] However, stakeholders consistently described Japan's innovation financing model as structurally hybrid, combining VC with corporate investment, public funding, and policy-linked instruments. This configuration risks slowing down the commercialisation of deep tech and life science. Cases such as Cyberdyne, a deep-tech firm from Tsukuba with roots at the university, demonstrate that scale-up is feasible, but typically proceeds through longer, less standardised pathways, reflecting the relative absence of streamlined, venture-led growth mechanisms.

Foreign Presence and International Connectivity

Tokyo–Yokohama functions as Japan's primary international gateway, with a growing foreign science and innovation presence structured through formal diplomatic, institutional, and corporate interfaces that link international research and industrial systems with Japanese partners.

For Sweden, this presence is institutionalised through multiple complementary interfaces. The Office of Science and Innovation (OSI) at the Embassy of Sweden in Tokyo provides a formal diplomatic interface for STI cooperation by mediating dialogue, policy exchange, and research collaboration. The Swedish Chamber of Commerce in Japan (SCCJ) functions as a locally embedded platform for business networking and trust-building, while Business Sweden assists in market entry and industrial collaboration. The Swedish Innovation Agency, Vinnova, increases engagement with research funding and cooperates with Japanese counterparts through targeted thematic initiatives on, for instance, semiconductors, 6G, and advanced connectivity.

While institutional interfaces and research collaboration are comparatively strong, joint venture creation and scale-up partnerships remain more limited. Mobility flows, particularly PhD pathways and structured researcher circulation between firms, were described as modest relative to the technological complementarities of the two systems. As a result, opportunities lie less in expanding formal representation than in deepening translational and industry-linked collaboration mechanisms within existing institutional frameworks.

Comparable arrangements exist with other countries. Switzerland's Swissnex operates a dedicated science and innovation outpost in Tokyo, while initiatives such as Innovation Centre Denmark and the German Center for Research and Innovation (DWIH Tokyo) combine science diplomacy, innovation support, and academic–industry matchmaking. Similarly to Swedish initiatives, such presence tends to prioritise policy engagement and market access over early-stage venture formation, thereby distinguishing Tokyo–Yokohama from more venture-centric international innovation hubs such as Boston-based foreign innovation offices. Nonetheless, foreign actors increasingly show interest in deeper, platform-based engagement with Tokyo–Yokohama's ecosystem, particularly through metropolitan and sector-focused intermediaries such as TIB and LINK-J. This reflects the growing recognition of Tokyo–Yokohama not only as a market, but as a strategic site for long-term collaboration.

Systemic Challenges and Opportunities

Across interviews, coordination – rather than capacity – was repeatedly identified as

*Interview evidence refers to a range of public and semi-public ecosystem initiatives oriented toward cross-organisational collaboration rather than venture financing. Examples include ecosystem-building platforms such as Wellbeing Ecosystem – Advanced Tokyo (WE-AT), which adopts a broad definition of wellbeing aligned with OECD frameworks, encompassing health, environment, work, education, and social conditions[29] and brings together universities, companies, and international partners. Other examples include LINK-J, which facilitates translational research and industry – academia interaction in the life sciences; Shonan iPark, representing an industry-led open innovation model in pharmaceuticals and healthcare; and SusHi Tech Tokyo, which functions as an international convening, branding, and matchmaking platform.

the central systemic challenge facing the Tokyo–Yokohama innovation system. Fragmented governance, overlapping programmes, and inconsistent incentives across ministries, agencies, and institutional layers complicate navigation and slow the translation from research to innovation and scale-up. Such structural frictions are exacerbated by persistent talent bottlenecks, limited inward mobility for foreign researchers and funders, and underdeveloped mechanisms for industry–academia circulation. Discussions with stakeholders further indicate that the metropolitan cost environment constrains start-up scaling and international recruitment.

Opportunities therefore lie in improving permeability without undermining stability: enhancing cross-sector mobility, leveraging metropolitan platforms for international and translational engagement, and aligning existing mission-oriented programmes more closely with industrial and societal needs. The emphasis is on strengthening interfaces rather than introducing parallel structures. Incremental improvements in coordination, rather than structural overhaul, were widely seen as the most realistic way to increase system responsiveness while preserving the long-term continuity that underpins Tokyo–Yokohama's innovation performance.

Internationalisation and Collaboration

This section analyses patterns of internationalisation and collaboration within the Tokyo–Yokohama cluster, examining how global connectivity is organised and its effect on the formation of international research and innovation partnerships.

International Positioning

Internationalisation is a defining but uneven feature of the Tokyo–Yokohama cluster. The region is deeply embedded in global research, industrial, and innovation networks, yet the intensity and form of international engagement vary markedly across institutions, sectors, and functions.

Internationalisation in Tokyo–Yokohama is best understood as a system-level property, anchored in metropolitan scale, institutional density, and functional specialisation. Spatial proximity of multiple stakeholders plays a central enabling role, even as individual organisations adopt different degrees and modalities of openness.

Patterns of International Scientific Collaboration

Bibliometric indicators point to a globally connected but still nationally anchored system. Approximately 55% of scientific publications originating from the cluster involve international co-authors, whereas only around 7% of PCT patent applications list foreign partners as co-inventors.[13] This asymmetry reflects strong international engagement in upstream research alongside more domestically rooted innovation and commercialisation activities.

International collaboration is most pronounced in physics and materials science, life sciences and biomedicine, ICT, and emerging domains such as AI and quantum technologies.[16] At the same time, collaboration is highly concentrated within a limited group of elite institutions – notably UTokyo, Science Tokyo, Keio University, RIKEN, and selected national laboratories. Smaller universities and institutes participate more selectively, producing a two-tier internationalisation structure in which globally visible anchor institutions account for a disproportionate share of international collaboration.

Corporate Internationalisation and Global R&D Networks

Major Japanese firms headquartered or operating R&D centres in Tokyo–Yokohama maintain extensive global R&D networks linking the region to North America, Europe, and other parts of Asia. Nevertheless, there is growing internal differentiation within corporate R&D. Some research units operate as globally oriented nodes that work largely in English, recruit internationally trained PhDs, and publish in peer-reviewed journals, while others remain more domestically embedded, with selective and function-specific international engagement aligned closely with product development and business units.

This dual structure supports international

competitiveness while shaping how foreign partners – including Swedish actors – engage with Japanese firms. Collaboration most commonly takes the form of joint development projects, applied research partnerships, and systems integration, rather than fully integrated multinational R&D teams. While effective in the short to medium term, this model raises longer-term questions about talent competition and sustained openness in rapidly advancing domains.

Universities, Constraints, and Enabling Programmes

International engagement within universities remains largely researcher-driven rather than centrally coordinated. Institutional risk-taking in international collaboration is discouraged by factors such as administrative burdens, compliance requirements, and due diligence in research security.*

At the same time, English-language graduate education, joint laboratories, and internationally oriented research platforms have expanded at leading institutions, particularly where autonomy and stable funding are available. WPI centres, alongside selective doctoral and postdoctoral initiatives, illustrate ways in which institutional design may lower barriers to international participation.

Responsible International Engagement in S&T

Tokyo–Yokohama's international connectivity is increasingly shaped by considerations of responsibility and risk management. Metropolitan and local actors – including the Tokyo Metropolitan Government, Yokohama City, and Kanagawa Prefecture – actively promote international exchange through overseas offices, inbound delegations, and city-level innovation diplomacy, thus reinforcing the region's gateway function.

Against a more complex geopolitical backdrop, Japan's approach to international collaboration is best characterised as risk management rather than risk aversion. Policy efforts seek to preserve openness while strengthening governance, ethical standards, and accountability. This has contributed to a gradual shift toward longer-term partnerships with clearer expectations regarding governance, reciprocity, and societal objectives.

Implications for Sweden – Japan Collaboration

For Sweden, Tokyo–Yokohama represents a high-capacity but structurally intricate collaboration environment. Interview insights suggest that engagement is most effective when:

- anchored in leading universities and national research institutes
- aligned with mission-oriented domains such as sustainability, advanced materials, life sciences, digitalisation, and emerging technologies
- built through long-term institutional partnerships, rather than ad hoc or project-based collaboration

Effective collaboration therefore depends on a dual-layer approach: formal, institution-level frameworks that provide legitimacy and continuity combined with sustained engagement at the level of individual research groups, where research agendas and collaboration decisions are ultimately shaped.

Sweden and Japan exhibit a high degree of complementarity, particularly where Japanese industrial capabilities intersect with Swedish strengths in systems thinking, governance, sustainability, and human-centred innovation. Sustaining this alignment relies less on episodic projects than on connective institutional infrastructure, supported by governmental and non-governmental actors on both sides, that facilitates continuity over time. In contrast to US ecosystems characterised by venture-led scale-up, and Chinese clusters shaped by strong state steering and platform-based industrialisation, collaboration in Tokyo–Yokohama more commonly operates through co-development, systems integration, and durable institutional partnerships. This system-level configuration explains why effective Sweden – Japan cooperation depends on patience, continuity, and institutional embeddedness rather than rapid project turnover.**

Institutional and Academic Partnerships

A dense network of university and research-institute partnerships underpins Sweden – Japan collaboration, with many of the most active and long-standing links centred in the Tokyo–Yokohama region. These collaborations are typically multi-faceted, combining institutional agreements, researcher mobility, and thematic research programmes. The most sustained engagement is concentrated in life sciences, materials science, and advanced engineering.

University-level Partnerships

UTokyo maintains a formal strategic partnership with the Stockholm Trio – KTH Royal Institute of Technology, Karolinska Institutet, and Stockholm University – established in 2017-2018 as a long-term, institution-level alliance rather than a collection of standalone projects. This partnership spans life sciences and medicine, materials science, sustainability, data science, and policy, and is implemented through joint research projects, coordinated mobility schemes, workshops and symposia as well as sustained engagement between academic leadership and faculty.

In parallel, the UTokyo – KI LINK platform, launched in 2023, provides a focused bilateral interface between UTokyo and Karolinska Institutet that functions as a thematic complement to broader institutional partnerships. The platform links UTokyo's Institute for Quantitative Bio-

*Due diligence here refers to partner screening, research security, and compliance procedures associated with international research collaboration.

**This characterisation draws on OECD analyses of national innovation systems (OECD 2019; 2021; 2023), WIPO GII cluster reports, and Japanese policy and research-system studies (NISTEP; RIETI), which consistently distinguish VC-driven US ecosystems, state- and platform-led Chinese clusters, and Japan's institution-centred, co-development-oriented innovation model.

sciences with Karolinska Institutet's departments of cell and molecular biology and biosciences and nutrition to support collaboration in molecular biology, immunology, neuroscience, and translational medicine through joint seminars, researcher exchange, and seed funding.

Discipline-specific Collaboration

Science Tokyo maintains discipline-specific collaboration agreements with Swedish universities across science, engineering, medical, and dental fields. In science and engineering, agreements with KTH Royal Institute of Technology, Chalmers University of Technology, Uppsala University, and Linköping University support joint research and academic exchange. In the medical and dental sciences, faculty-level agreements with the University of Gothenburg, particularly through the Sahlgrenska Academy and the Institute of Odontology, as well as with Linköping University reflect a selective, field-focused collaboration pattern.

This structure illustrates a recurring feature of Sweden–Japan collaboration: partnerships tend to deepen where disciplinary alignment and institutional identity coincide, rather than expanding uniformly across fields.

Private Universities and Networks

Keio University maintains university-wide student exchange agreements with several Swedish universities, including KTH Royal Institute of Technology, Lund University, the University of Gothenburg, and Uppsala University, alongside a research collaboration agreement with Karolinska Institutet focused on biomedicine and health. These arrangements combine broad educational exchange with more targeted research-intensive cooperation.

Waseda University participates in the MIRAI network,* contributing to multilateral Sweden–Japan collaboration through thematic research activities, mobility, and early-career engagement. In parallel, Waseda maintains education-focused agreements with Swedish partner institutions that emphasise student mobility, including short-term and summer programmes. Together, these arrangements reflect a decentralised and student-driven model of engagement that complements research-intensive partnerships elsewhere in the system.

National Research Institutes

Beyond universities, national research institutes play an important role. The RIKEN Center for Life Science Technologies (CLST)** has long-standing cooperative relationships with Swedish partners, notably with Karolinska Institutet and SciLifeLab, Sweden's national centre for molecular life sciences. These links predate the formal establishment of CLST and reflect collaboration built incrementally over many years through joint research and doctoral training.

Overall Pattern

Taken together, Swedish–Japanese institutional and academic partnerships in the Tokyo–Yokohama cluster are characterised by durability, thematic focus, and organisational embeddedness. Collaboration is concentrated in a limited number of institutions and disciplines, where complementary strengths align with stable frameworks and sustained leadership engagement. This pattern reinforces the importance of deepening existing institutional corridors rather than pursu-

*The MIRAI network is a structured, multi-institutional framework for Sweden–Japan academic collaboration, initiated in 2017–2019 by seven Swedish and eight Japanese universities and currently involving 17 partner universities across both countries. It supports long-term research collaboration, thematic networks, researcher mobility, and early-career development, while promoting Sweden and Japan as countries with world-leading large-scale research infrastructure. The current phase, MIRAI 3.0 (2024–2026), represents the latest iteration of this collaboration and provides institutional continuity across funding cycles, with several Japanese partners located in the Tokyo–Yokohama region.

**From April 1, 2018, CLST was reorganized into three centers: Center for Integrative Medical Sciences, Center for Biosystems Dynamics Research, and RIKEN SPring-8 Center.

[Methodological notes]
(i) Institute of Science Tokyo (commonly referred to as Science Tokyo) was formally established in October 2024 through the merger of Tokyo Institute of Technology and Tokyo Medical and Dental University. In Scopus and SciVal the merger has been processed retrospectively, meaning all publication data are attributed to the combined institution, irrespective of the period. The 2015–2024 series therefore reflects the consolidated profile of Science Tokyo throughout.

(ii) The shares of Swedish institutional collaboration are calculated relative to each Japanese institution's total number of publications linked to Sweden. Because individual publications may involve multiple Swedish co-authors from different institutions, percentages are not mutually exclusive and will exceed 100% when aggregated across Swedish partners.

ing broad but shallow expansion.

Bibliometric Snapshot of Sweden Co-authorship (2015–2024)

This section presents a bibliometric snapshot of Sweden–Japan research collaboration within the Tokyo–Yokohama cluster to inform strategic partnership considerations. The analysis focuses on co-authored scholarly output involving the three institutions identified in the WIPO GII cluster – UTokyo, Science Tokyo, and Keio University – using SciVal (Scopus) data covering the period 2015–2024.

Scale and Growth

Co-authorship with Sweden increased across all three institutions over the decade, although at markedly different rates. UTokyo expanded from 287 publications in 2015 to 638 in 2024 (+122%; CAGR ~9.3%), with acceleration in the early 2020s. Science Tokyo grew more modestly, from 165 to 201 publications (+21.8%; CAGR ~2.2%), following an uneven trajectory. Keio University recorded the strongest relative growth, from 21 to 63 publications (+200%; CAGR ~13.0%), albeit from a small base.*

Combined Sweden-linked output across the three institutions increased from 473 publications in 2015 to 902 in 2024 (+90.7%). This growth remains structurally concentrated: UTokyo accounts for 61–73% of annual Sweden co-authored output across the period and 70.7% of the combined total in 2024, indicating that recent expansion is driven primarily by UTokyo rather than a broad rebalancing across the cluster.**

When contextualised against each institution's total internationally co-authored output, Sweden represents a proportionally significant partner for all three institutions. This is particularly evident for Science Tokyo, where Sweden-linked publications account for 9.6% of total international co-authorship, reflecting a dense but specialised collaboration profile rather than diffuse engagement.

University of Tokyo (Total Sweden-linked publications 2015–2024: 4,181)
UTokyo's collaboration with Sweden is broadly distributed across Sweden's major comprehensive and technical universities, led by Stockholm University, KTH Royal Institute of Technology, Lund University, and Uppsala University. The comparatively smaller share involving Karolinska Institutet reflects a collaboration profile weighted toward basic science and engineering rather than biomedicine.

Swedish Institution	Co-authored Publications	Share of Collaboration
Stockholm University	2,022	48.4%
KTH Royal Institute of Technology	2,011	48.1%
Lund University	1,916	45.8%
Uppsala University	1,692	40.5%
Karolinska Institutet	503	12.0%

Science Tokyo (Total Sweden-linked publications 2015–2024: 1,773)
Collaboration is strongly focused on Sweden's technical and comprehensive universities, particularly KTH and Lund University. Proportionally, Sweden is the strongest of Science Tokyo's international bilateral partners, thus confirming an intensive engineering and science-oriented collaboration corridor. Consistent with Science Tokyo's institutional profile, biomedical collaboration remains limited.

Swedish Institution	Co-authored Publications	Share of Collaboration
KTH Royal Institute of Technology	1,217	68.6%
Lund University	1,210	68.2%
Stockholm University	1,153	65.0%
Uppsala University	1,148	64.7%
Karolinska Institutet	197	11.1%

Keio University (Total Sweden-linked publications 2015–2024: 428)
Keio has the most intensive collaboration with Sweden and its focus is distinctly biomedical. Nearly half of all Sweden-linked publications involve Karolinska Institutet, reflecting Keio's medical and life science orientation and its dedicated research collaboration agreement with Karolinska.

Swedish Institution	Co-authored Publications	Share of Collaboration
Karolinska Institutet	202	47.2%
Lund University	108	25.2%
Uppsala University	99	23.1%
KTH Royal Institute of Technology	92	21.5%
Stockholm University	89	20.8%

*CAGR is calculated as (Final Value/Initial Value) ^ (1/n)-1, where n is the number of years. It smooths year-to-year fluctuations and provides a standardised measure for comparing growth trajectories across institutions of different sizes.

**Combined figures are derived by summing annual Sweden-linked publication counts across the three institutions (UTokyo + Science Tokyo + Keio University) for each year. Because a single publication co-authored by more than one of the three Japanese institutions would be counted more than once, combined totals should be interpreted as the sum of institutional outputs rather than a deduplicated cluster-level figure. The share range of 61–73% reflects year-to-year variation across the full 2015–2024 period; the 70.7% figure refers specifically to 2024 (638 of 902).

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Key Takeaways

- Sweden–Japan collaboration in the Tokyo–Yokohama cluster is selective but deep, anchored in a limited number of institutions, disciplines, and long standing relationships.
- Effective cooperation is shaped by Japan's institution centred innovation system, favouring co development, systems integration, and durable partnerships over rapid, venture-led scale up.
- Academic, industrial, and public sector links are most effective when supported by institutional connective infrastructure that enables continuity across research, mobility, and applied collaboration.

Comparative Patterns

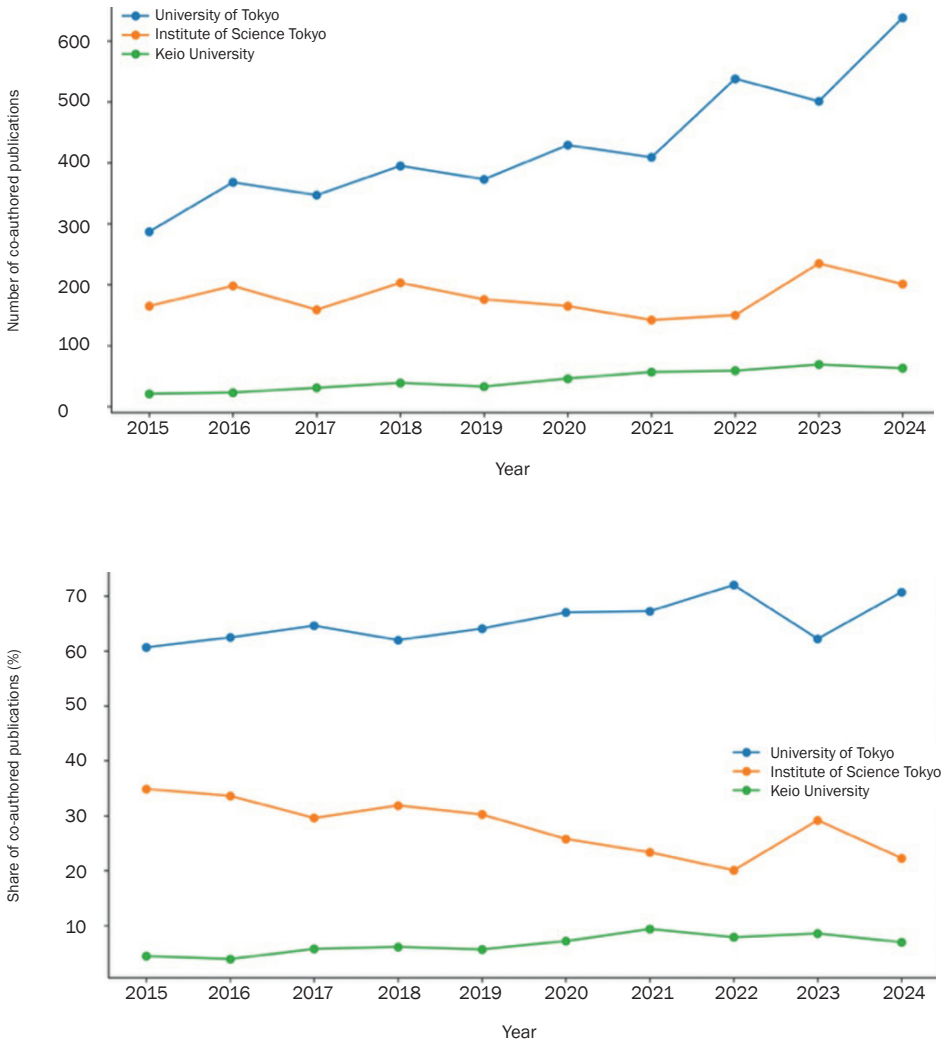
Taken together, the Swedish collaboration profiles of these three institutions are clearly differentiated and align with their respective disciplinary identities. UTokyo provides scale and breadth; Science Tokyo anchors a particularly active technical and engineering corridor; and Keio's engagement is concentrated in biomedical networks. Therefore, while collaboration between Swedish universities and these Tokyo institutions is expanding, it remains structured along distinct institutional and disciplinary lines rather than evenly distributed across the cluster.

Applied Research and Industry Links

The presence of Swedish companies in the Tokyo–Yokohama region provides an important base for applied research collaboration and technology development, complementing academic and public-sector partnerships. These industry links are typically oriented toward joint development, piloting, and systems integration rather than stand-alone corporate research laboratories.

AstraZeneca represents the most deeply embedded Swedish R&D actor in the cluster. It maintains extensive engagement

Figure 1. Sweden–Japan Co-authored Publications (2015–2024). **(A)** The annual number of scholarly publications co-authored with Swedish institutions (international collaboration) for UTokyo, Science Tokyo, and Keio University, 2015–2024. Values represent the total Sweden-linked co-authored outputs per year based on Scopus/SciVal publication set exports. **(B)** The annual share (%) of total co-authored publications with Sweden across the three Japanese institutions shown in Panel A illustrates the relative concentration of Sweden-linked collaboration within the group over time.



with Japanese universities, hospitals, and research institutes, particularly in oncology, cardiovascular and metabolic disease, and translational medicine, thus illustrating how sustained industrial presence can reinforce long-term research collaboration within Japan's institution-centred innovation system.

Other Swedish firms, including Ericsson, ABB, and Volvo Group, maintain a strong presence focused on applied collaboration in areas aligned with Japan's industrial priorities, such as next-generation telecommunications, electrification and energy systems, mobility, automation, and digital infrastructure. These engagements are generally project-based and linked to joint development or demonstration activities, rather than centred on large in-house R&D facilities.

In parallel, Swedish start-ups are increasingly entering the Tokyo–Yokohama ecosystem through specialised accelerators, innovation districts, and metropolitan platforms, particularly in health technologies, deep tech, and sustainability. For many of these firms, the region functions primarily as a platform for market entry, technology validation, and early-stage internationalisation, rather than as a primary location for core R&D.

Discussion: Structural Characteristics and Transformation Dynamics

Tokyo–Yokohama's position as a leading global S&T cluster rests on exceptional institutional density, scientific breadth, and deep industrial foundations built through long-term accumulation rather than a single policy intervention or dominant sector. The cluster's scale and diversity underpin its resilience and sustained output across research, patenting, and industrial innovation, while also shaping distinctive structural constraints.

A defining characteristic of the system is its layered institutional architecture. Universities, national research institutes, corporate R&D laboratories, and public agencies are concentrated and functionally interconnected, yet organisational boundaries remain strong. Interview evidence consistently indicates a configuration that is simultaneously robust and compartmentalised: capable of sustaining long-horizon research and cumulative capability, but slower to reconfigure in response to emerging technological and organisational shifts.

This duality is particularly visible in the interaction between stability and adaptability. Long-standing institutional anchors and mission-oriented programmes provide continuity and risk-absorbing capacity, supporting large-scale infrastructure, basic research, and industrial co-development. At the same time, the same features contribute to coordination challenges, limited labour mobility, and uneven diffusion of internationally oriented practices across the system.

Transformation dynamics within Tokyo–Yokohama are therefore incremental rather than disruptive. Change tends to occur through institutional layering, selective experimentation, and platform-based coordination, avoiding rapid turnover of firms or wholesale restructuring. Initiatives such as metropolitan innovation platforms, ecosystem intermediaries, and internationally oriented research programmes seek to increase permeability across organisational boundaries, yet operate within – rather than outside – existing governance architecture.

Internationalisation follows a similar pattern. The cluster is highly connected at the system level, yet openness is unevenly distributed across institutions and functions. Globally visible universities, national research institutes, and selected corporate R&D units act as primary international interfaces, while other parts of the system remain more domestically embedded. This produces strong international performance in upstream research, alongside more nationally based innovation and commercialisation pathways.

From a comparative perspective, Tokyo–Yokohama differs from venture-led ecosystems characterised by rapid firm turnover and from state-directed clusters structured around platform firms. Its innovation model is institution-centred and co-development-oriented. It privileges continuity, systems integration, and cumulative expertise over speed and scale-up intensity. These characteristics help explain both the cluster's enduring global significance and the persistence of structural bottlenecks related to talent circulation, venture formation, and cross-sector mobility.

Overall, the challenge faced by the Tokyo–Yokohama cluster is not a lack of scientific or technological capacity, but the optimisation of coordination and permeability within a dense and deeply institutionalised system. Future competitiveness will depend on improving connectivity across organisations, sectors, and international partners, while preserving the stability that underpins Japan's industrial and research strengths.

Strategic Implications and Recommendations for Sweden

This section maps the institutional architecture of Sweden–Japan academic and research partnerships within the Tokyo–Yokohama cluster, examining how durability, thematic focus, and organisational embeddedness shape collaboration outcomes. Building on the preceding analysis, it distils strategic implications and formulates recommendations to strengthen Sweden's engagement with key actors in the cluster.

Sweden's Positioning in the Tokyo–Yokohama Context

For Sweden, engagement with the Tokyo–Yokohama cluster requires moving beyond ad hoc cooperation toward approaches that leverage institutional continuity, trusted intermediaries, and clearly defined thematic focus areas. The cluster's scale and richness offer substantial opportunity, but effective engagement depends on selectivity, long-term commitment, and alignment with Japan's institution-centred innovation system.

Priority Domains for Sweden–Japan Collaboration

Drawing on interview insights and landscape analysis, several domains offer par-

Strategic Recommendations for Sweden

To translate these opportunities into sustained impact, the following strategic directions are recommended:

- *Differentiating by institution, not by bilateral framework*
  UTokyo offers scale and breadth; Science Tokyo is Sweden's proportionally strongest partner and a natural anchor for engineering and materials science collaboration; Keio's profile is concentrated in biomedicine through Karolinska. Each requires a distinct engagement approach.
- *Engaging proactively with Japanese ecosystem-building initiatives*
  Platforms such as WE-AT and LINK-J bring together multiple Tokyo–Yokohama anchor institutions and private partners, offering lower-friction entry points than stand-alone outreach.
- *Using industrial PhD models as a flagship bilateral instrument*
  The limited prevalence of industry-embedded doctoral pathways remains a key structural gap in Japan. Sweden's experience is directly relevant and could support long-term talent circulation.
- *Scaling existing partnerships rather than building parallel structures*
  Corridors such as Karolinska–Keio, the Stockholm Trio–UTokyo partnership, and UTokyo–KI LINK are active and trusted; the opportunity lies in deepening them toward translational medicine, ageing, and diagnostics.
- *Targeting metropolitan platforms for applied engagement*
  Tokyo Innovation Base and King SkyFront offer priority entry points for Swedish deep-tech and health-tech collaboration.

ticularly strong potential for expanded collaboration within the Tokyo–Yokohama ecosystem:

- Quantum technologies and semiconductors, where complementarities with Japanese national research institutes, advanced manufacturing capabilities, and long-term industrial investment are pronounced.
- Hydrogen, electrification, and sustainable manufacturing, aligned with Japan's Green Innovation agenda and Sweden's strengths in renewable energy systems, industrial decarbonisation, and systems integration.
- AI governance and responsible digital systems, combining Japan's technological capabilities with Swedish expertise in regulatory frameworks, ethics, and public-sector innovation.
- Health and ageing, spanning biomedicine, diagnostics, assistive technologies, robotics, and preventative care, where demographic challenges and translational research priorities closely align.

In parallel, the expansion of innovation districts and research-based start-up activity in Tokyo–Yokohama creates growing opportunities for collaboration in deep-tech entrepreneurship, piloting, and early-stage scale-up – particularly where Swedish actors engage through structured platforms rather than isolated market entry.

Conclusion

The Tokyo–Yokohama S&T cluster remains one of the world's most significant metropolitan concentrations of research and innovation capacity. Its global position is grounded in exceptional institutional density, scientific breadth, and deep industrial foundations built through long-term accumulation. Recent changes in international benchmarking frameworks have altered the cluster's formal ranking, but not its underlying strengths in research output, patenting, and industrial R&D.

At the same time, a systematic duality persists. The same structural features that underpin resilience, continuity, and cumulative capability also generate coordination challenges, restrict labour mobility, and dampen system-wide responsiveness. Transformation therefore unfolds mainly through incremental recalibration of existing arrangements, selective experimentation, and platform-based coordination, not disruptive restructuring.

Internationalisation reflects this pattern. Tokyo–Yokohama is highly connected at the system level and functions as Japan's primary international research gateway, yet international engagement remains unevenly distributed across institutions and functions. Leading universities, national research institutes, and selected corporate R&D units account for a disproportionate share of global connectivity, while other parts of the system remain more domestically embedded.

For Sweden, Tokyo–Yokohama represents a high-capacity but institutionally complex collaboration environment. These findings suggest that effective engagement depends less on expanding the breadth of cooperation than on deepening selected institutional and thematic corridors where complementarities are strongest – particularly in advanced materials, life sciences, digital technologies, sustainability, and deep-tech fields. Aligning engagement strategies with the cluster's institution-centred innovation model offers a pragmatic pathway for sustained, high-impact collaboration.

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