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THE RESILIENCE AXIS

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Introduction

The 4th India Japan Forum (IJF), held on 7-8 December 2025 in New Delhi, captured critical insights into deepening bilateral ties amid global volatility. This forum, through its inaugural keynote and 10 comprehensive sessions, underscored the evolving strategic partnership between India and Japan, addressing economic resilience, supply chain vulnerabilities, and great-power dynamics in the Indo-Pacific. Global uncertainties in 2025, including managed US-China competition, improved yet tense India-China relations, and stable QUAD momentum with multiple ministerial meetings, set the stage for the forum. The inaugural keynote expanded security definitions to encompass economic, food, maritime, and resource domains, highlighting advanced manufacturing as a pivotal area for collaboration to counter supply chain risks. It also noted a strategic Indo-Pacific gap where India-Japan cooperation could complement selective US engagement. Sessions delved into semiconductors as a $1.6 trillion chokepoint by 2030, proposing India- Japan synergy in design, wafers, and magnets to rival China. Discussions on supply chain resilience prioritised steel, automotive, green hydrogen, EVs, and SMEs, drawing on Japan's post-WWII models and successes, such as Maruti Suzuki. Nuclear energy, digital public infrastructure (DPI), critical minerals, defence co-production, human capital mobility (targeting 500,000 students and 50,000 skilled workers), and trade-investment barriers featured prominently, advocating hedging strategies through alternatives such as India-Europe ties. Recommendations urged regulatory harmonisation, financial expansion for SMEs, trusted data flows, and pilots like an India-Sri Lanka-Japan corridor. Emphasising "design in Japan, make in India, made for the world," the forum called for overcoming FDI hurdles by standardising land processes and balancing IP rights. These takeaways reinforce India-Japan relations as investment-driven beyond market access, vital for FOIP's 10th anniversary in 2026.

CHAPTER 1

RESILIENT FUTURES: THE ECONOMIC SECURITY AGENDA

Introduction

Economic security has emerged as a defining pillar of contemporary international partnerships in the context of intensifying geopolitical competition, technological disruption, and systemic vulnerabilities in global supply chains.

For India and Japan, economic security is a strategic imperative that intersects with national security, industrial policy, and regional stability in the Indo-Pacific region.

Resilience is not just about crisis management; it is also about structural preparedness – the capacity to anticipate, absorb, and leverage disruption.

The India-Japan partnership, grounded in trust, complementarity, and shared strategic interests, is uniquely positioned to do this. However, translating strategic convergence into tangible economic and technological outcomes remains a challenge.

This chapter analyzes the structural constraints and opportunities of Indo-Japanese cooperation in economic security, distills the lessons learnt so far, and proposes actionable policy recommendations for deepening the relationship and taking it forward.

Economic Security as a Strategic Imperative

The dialogue spotlighted the shift in the relationship from a traditional trade partnership to a security-infused framework in which geopolitical rivalries such as the one between the United States and China position trade and supply chains as tools of leverage.

Technologies such as semiconductors, artificial intelligence (AI), critical minerals for batteries and renewables, and digital infrastructure have become the core battleground of the Indo-Pacific, compelling both nations to pursue joint ventures that reduce reliance on dominant external suppliers.

This has reoriented supply chains from cost efficiency to resilience, trust, and diversification, and safeguarding interests against global shocks through 'middle-power cooperation', in which aligned nations pool their strengths to challenge bipolar dominance.

Japan's postwar industrial experience underscores the indispensable role of Small and Medium Enterprises (SMEs) in building a durable industrial base, linking large corporations with nimble suppliers to form self-reinforcing clusters. This offers a template for India's expansive but technologically shallow MSME sector, which continues to struggle with productivity and global value-chain integration.

SMEs can help link large corporations with specialized suppliers to produce resilient clusters that are capable of sustained technological upgradation and export competitiveness.

Emulating the Japanese keiretsu model of cross-shareholding in an interconnected network of companies could help build industrial clusters in semiconductors, batteries, and minerals. To generate assured demand and scale capabilities however, strategic interventions such as gusted,

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companies could help build industrial clusters in semiconductors, batteries, and minerals. To generate assured demand and scale capabilities however, strategic interventions such as government procurement, defence contracts, and industrial policies will be needed.

Ecosystems Based on Trust, Synergies, Regionalization

Trust is a cornerstone strategic asset, nurtured by people-to-people ties and institutional bonds that unlock cooperation in sensitive realms. The India-Japan partnership demonstrates this vividly: decades of cultural exchanges and steadfast diplomacy have enabled high-stakes advances in AI, defence technology, and supply chains, and shown that mutual confidence can achieve what purely transactional approaches cannot.

Economic security, which is inherently political in nature, demands that industrial policy, technology partnerships, and supply-chain decisions are treated as geopolitical imperatives; this is because vulnerabilities in critical sectors can directly imperil sovereignty.

Public-private coordination, facilitated by multilateral frameworks such as the Quad, the Semiconductor Supply Chain Resilience Initiative, and India-Japan-Australia trilaterals, is essential for success. The presence of ASEAN as a regional economic anchor makes it essential that the cooperation includes Australia, Taiwan, and others for energy transitions and mineral security, transforming bilateral efforts into Indo-Pacific-wide resilience strategies.

Beyond megaprojects, it is critical to build holistic ecosystems that interconnect large firms, MSMEs, research institutions, and governments. These linkages are necessary to stimulate innovation in batteries, renewables, and digital infrastructure, without which India's Production-Linked Incentive (PLI) schemes risk the risk of being isolated.

Navigating Alignment Gaps and Reform Challenges

India and Japan share strong strategic convergence on economic security, but an operational chasm persists. Japanese corporate enthusiasm, as seen in Suzuki's expansion, is evident, but SME investments lag, stifled by regulatory uncertainty and perceived risk. In India, reforms such as the Goods and Services Tax, implementation of the labour codes, and the insolvency framework signal resolve, but gaps remain in the consistency, transparency, and predictability of implementation. For risk-averse Japanese SMEs, the perceived policy flux outweighs the formal legal environment, which underlines that certainty of execution is as important as the reform itself.

In the landscape of a US-China technology duopoly, India and Japan must navigate the middle-power bind, balancing alliances that ensure access to technology against building strategic autonomy in the face of export controls and intellectual property threats. Joint capacity-building with Quad and ASEAN partners is therefore critical to shape global technology architectures. Without technological deepening and integration of MSMEs, supply chain resilience will remain structurally incomplete.

The India-Japan relationship offers a blueprint for middle-power agency, but the realization of its full potential in an increasingly fragmented international order depends on regulatory streamlining, uplift of MSMEs, orchestration of demand, cultivation of trust, and regional embedding.

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"Supply chains now need to be trusted, not only cheap. In today's world, resilience is not just about survival; it is a competitive advantage."

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Institutionalizing High-Level Cooperation & Aligned Strategies

Policymakers should prioritize establishing a permanent India-Japan Economic Security Council, drawing in government officials, industry leaders, and academics to steer collaboration.

This body would align national industrial strategies via joint roadmaps on semiconductors, AI, critical minerals, and energy technologies, ensuring synchronised investments that amplify bilateral strengths amid geopolitical flux. By formalising dialogue, it would preempt misalignments and foster a unified front against supply-chain vulnerabilities.

Building Joint Ecosystems and MSME Linkages

Bilateral technology testbeds in semiconductors, 6G, and AI safety would serve as innovation hubs, fusing Japanese hardware prowess with India's software and digital scalability. Joint platforms could link manufacturing expertise to digital capabilities, and cluster-based initiatives could pair Japanese SMEs with Indian MSMEs in dedicated

zones. To ease entry for smaller firms, an India-Japan MSME Partnership Programme could offer regulatory facilitation, risk-sharing through mechanisms such as credit guarantees, and anchored supply chains through large corporations such as Suzuki or Tata, mirroring the keiretsu model of building resilient, localised ecosystems.

Generating Strategic Demand, Safeguarding Critical Sectors

Strategic industries require proactive demand-creation. Coordinated government procurement favouring trusted suppliers, along with joint defence and infrastructure frameworks, can create scalable markets for semiconductors, batteries, and renewables.

India and Japan could explore measures such as targeted subsidies or public stockholding to shield nascent sectors, drawing lessons from Japan's semiconductor revival and India's PLI schemes. The goal should be to facilitate the emergence of domestic champions without relying overly on volatile global markets.

Bolstering Regulatory Predictability & Investor Confidence

Effective execution of reforms is key.

A dedicated Japan Desk in agencies such as the Department for Promotion of Industry and Internal Trade (DPIIT) under the Ministry of Commerce and Industry, NITI Aayog, and state investment boards could proactively resolve investor concerns. Standardising the implementation of regulations across states through unified guidelines and digital portals would reduce unpredictability. Expanding fast-track approvals and investor-state dispute mechanisms, including through bilateral investment treaty updates, would reassure risk-averse SMEs whose caution currently limits flows despite rising corporate interest.

Regionalizing Efforts and Investing in Human Capital

Economic security cannot remain bilateral. Weaving India-Japan initiatives into Quad, ASEAN, and trilateral frameworks for regional supply chains in minerals, energy transitions, and digital infrastructure — including the coordination of standards in forums such as the WTO and the International Organisation for Standardisation — is essential to resist fragmentation.

Talent pipelines should be widened through expanded exchanges in AI, semiconductors, and manufacturing. Co-development of data centres and research hubs, alongside skilling programs that leverage India's demographic strength and Japanese expertise, can sustain long-term competitive advantage.

Conclusion

The India-Japan partnership is at an inflection point. A concrete agenda of economic security will determine the trajectory of bilateral cooperation and regional stability going forward. While strategic alignment is strong, the challenge lies in building operational capacity, industrial ecosystems, and institutional mechanisms that translate shared vision into tangible outcomes.

If effectively harnessed, India-Japan cooperation in economic security can not only strengthen bilateral resilience but also shape the architecture of the Indo-Pacific economic order. The transition from dialogue to delivery will define the next phase of the partnership.

Toshimitsu Motegi, Foreign Minister of Japan

CHAPTER 2

THIRD HORIZON: EXPANDING BILATERAL COOPERATION ACROSS BORDERS

Introduction

India-Japan relations have evolved from a primarily bilateral partnership into a strategic collaboration with regional and global implications. As geopolitical fragmentation intensifies, supply chains are reconfigured, and minilateral frameworks gain prominence, the logic of extending India-Japan cooperation beyond national borders has become increasingly compelling.

The panel discussion on 'Expanding India-Japan Bilateral Cooperation Beyond Borders' underscored the importance of third-country cooperation as an emerging pillar of the India-Japan strategic and global partnership. Infrastructure development, connectivity, maritime security, supply-chain resilience, and development cooperation in Asia, Africa, and the Indian Ocean Region were identified as key domains where India and Japan can jointly shape regional outcomes.

But the discussion also spotlighted the gap between strategic intent and operational execution. While India and Japan share converging interests and complementary capabilities, their cooperation in third countries remains below potential.

This chapter analyzes the strategic implications and policy pathways for expanding and deepening India-Japan cooperation beyond their borders.

Strategic Convergence in a Fragmented World

A dominant theme was improving India-Japan strategic harmony amid cascading global shocks, the weaponisation of trade, supply-chain vulnerabilities exposed by the pandemic, and geopolitical competition, all of which underline the need for reliable alliances and diversified networks. The two nations are uniquely equipped for the Indo-Pacific – combining democratic governance, proven development pathways, and cutting-edge technology to emerge as viable counterweights to hegemonic pressures, and offering stability where others falter.

Complementarity shapes their competitive edge. Japanese prowess in technology, financing, meticulous execution, and adherence to global standards dovetails with India's abundant human capital, Global South diplomacy, hands-on development expertise, and capacity to scale solutions at volume. The fusion of Japanese technology-finance precision and Indian on-the-ground agility can deliver enduring results in third-country arenas, avoiding the pitfalls of mismatched solo efforts.

Core Enablers: Infrastructure and Maritime Security

Trust and ambition have been the bedrock of India-Japan infrastructure cooperation, exemplified by achievements such as the operational efficiency of the Delhi Metro, the logistics transformation brought about by the Western Dedicated Rail Freight Corridor, and the proposed Mumbai-Ahmedabad High-Speed Rail. Third-country infrastructure initiatives in South Asia, Southeast Asia, and Africa can leverage these successes as tools for stitching regional connectivity, spurring economic integration, and projecting soft power.

Maritime security intertwines economics with

strategic imperatives. More than 95 per cent of India's trade and virtually all of Japan's trade is carried out by sea. The dialogue broadened the discussion beyond naval patrols to encompass optimized logistics, next-generation shipbuilding, undersea digital cables, cyber resilience, and AI-orchestrated surveillance to ensure that trade arteries remain resilient against hybrid threats.

From Bilateral Cooperation to Models of Minilateralism

India-Japan dynamics have evolved from an introspective bilateralism to expansive regionalism, driven by power play in the Indo-Pacific, the search for non-hegemonic development models, and the splintering of supply chains.

Middle powers are sculpting regional architectures by building nimble coalitions, eschewing lone-wolf postures. Minilaterals, trilaterals, and Quad offshoots are proving more effective than cumbersome large multilaterals thanks to their agility, sharper focus, and more manageable political dynamics. The Philippines and Sri Lanka stand out as ideal testing grounds for India-Japan-driven trilaterals.

Geostrategic priorities have crystallized around three theatres: (a) South Asia, where Sri Lanka beckons as a reconstruction pilot alongside ventures in Bangladesh, Nepal, Bhutan, and Myanmar to strengthen connectivity and offset rival influence; (b) Southeast Asia, where Japan's footprint in ASEAN meets Indian experiential heft, even though India lags in visibility; and (c) Africa and the Indian Ocean, a frontier for India's relational networks and Japanese technology infusions to forge sustainable, rules-based regional orders.

India's position as both a rising power and a genuine peer among developing nations is a strategic asset that allows it to bridge North-South divides, offer adaptable growth templates, and command credibility across the Global South. Together with Japan's technological and financial capabilities, it can create a partnership model that is capable of rivalling conventional Western aid or Chinese infrastructure investment.

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"India and Japan are perhaps the only two countries with both the strategic convergence and the complementary capabilities to offer credible alternatives across the Indo-Pacific."

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Political Economy Speedbumps, Lessons on Execution

The optimism is, however, tempered by significant constraints. India's integration into Japanese supply networks lags behind ASEAN's, and entrenched tariffs, regulatory haze, institutional mismatches, and weak public-private coordination slow the momentum. Deeper structural impediments include clashing bureaucratic cultures, corporate risk calculus, inconsistent policy signals, and sparse joint-project pipelines. All of this explains why the promise of strategic convergence seldom translates into actual granular cooperation.

Several lessons emerge. Strategic alignment does not automatically produce operational results, and dedicated institutional mechanisms matter more than summit communiqués. Infrastructure transcends its commercial function to serve as geopolitical capital, meriting strategic stewardship rather than routine project management. Private sector dynamism is lagging, and state-led initiatives cannot scale without a genuine fusion of Indian and Japanese enterprise. Policy predictability is a decisive variable, and replicating ASEAN-style integration requires sustained domestic reform. Finally, minilaterals offer the most suitable experimental crucibles for scalable models.

Institutionalizing Third-Country Coordination Mechanisms

To harness the momentum of their partnership, India and Japan must formalise third-country cooperation through a dedicated coordination structure – perhaps an annual summit or a standing secretariat to streamline project identification, risk assessment, and execution.

Joint task forces comprising government ministries, development banks such as JICA, and private players from both major conglomerates and SMEs, would operationalise this structure, curating a dynamic pipeline of ventures prioritized for South Asia, Southeast Asia, and Africa. Such mechanisms would go beyond ad hoc deals to embed strategic foresight into every initiative.

Harmonizing Finance, Standards, Supply Chain Synergies

Aligning development finance is pivotal.

Synchronising Indian lines of credit and Japanese overseas development assistance (ODA) through co-financing pilots via JICA, the Export-Import Bank of India, and multilateral institutions such as the

Asian Development Bank (ADB) and the Asian Infrastructure Investment Bank (AIIB), with unified benchmarks for transparency, sustainability, and local empowerment, will significantly enhance project impact. Along with this, dismantling Indian trade and regulatory barriers such as tariffs and cumbersome approvals will reposition India as an ASEAN-linked export hub.

Fostering trilateral industrial clusters such as an India-Japan-Sri Lanka cluster in textiles or electronics will weave in supply chains that reduce exposure to disruptions and amplify regional value addition.

Advancing Maritime, Connectivity, and Multilateral Frontiers

Maritime-economic integration demands acceleration. Scaling joint shipbuilding, logistics parks, smart ports, and technology infusions — including AI-enabled navigation and cyber-hardened systems — will dovetail security objectives with digital infrastructure development and decarbonised fleet transitions.

On connectivity, championing smart mobility including high-speed rail, green logistics, and integrated economic corridors, and building third-country replicas of bilateral successes such the Mumbai-Ahmedabad Rail, presents valuable opportunities.

Minilateral frameworks provide agile scaling pathways. Piloting trilaterals with Sri Lanka or ASEAN nodes, syncing Quad visions on supply-chain resilience and clean energy with tangible outputs like joint training centres, and engaging countries such as the Philippines and Australia for maritime drills or Africa-focused trilaterals will create networked proof-of-concept models that can overcome the limitations of bilateral silos.

Conclusion

The panel discussion underscored that taking India-Japan cooperation beyond borders is both a strategic necessity and an unrealised opportunity. Also, while the partnership is grounded in deep trust and complementarity, its potential remains constrained by institutional, economic, and operational barriers.

If effectively institutionalized and strategically directed, India-Japan third-country cooperation can emerge as a defining pillar of the Indo-Pacific order, offering sustainable development pathways, strengthening regional connectivity, and providing credible alternatives in an increasingly contested geopolitical environment.

The challenge ahead is not the absence of strategic vision, but the translation of that vision into coordinated action.


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CHAPTER 3

FUTURE OF THE DIGITAL ORDER: CYBER SAKE AND CHAI

Introduction

The digital domain has emerged as a central arena of geopolitical competition, economic transformation, and societal change. Semiconductors, digital public infrastructure, data governance, artificial intelligence, and cybersecurity now constitute strategic determinants of national power and international influence.

The panel discussion on India-Japan digital cooperation underscored that India and Japan are increasingly natural partners in shaping the evolving digital order, even as each country pursues its own distinct technological trajectory.

India's rapid, population-scale deployment of digital public infrastructure contrasts with Japan's incremental, trust-centric approach to digital governance. These differences, however, do not represent divergence. Rather, they reflect complementary strengths capable of underpinning a resilient, inclusive, and secure digital ecosystem across the Indo-Pacific.

This chapter examines the strategic rationale, opportunities, and constraints shaping India-Japan digital cooperation. It argues that the partnership can evolve beyond bilateral collaboration to influence regional norms, standards, and infrastructure development, provided both countries address emerging vulnerabilities and institutional gaps within their digital engagement architecture.

Economic Security as a Strategic Imperative

The discussion highlighted a constructive contrast between India's scale-driven digital transformation and Japan's emphasis on institutional trust and governance integrity.

India's experience with large-scale digital systems, including Aadhaar's biometric identification framework, the Unified Payments Interface (UPI), and interoperable digital stacks, demonstrates how population-scale infrastructure can rapidly expand financial inclusion, service delivery, and economic participation.

Japan's approach, by contrast, prioritizes privacy safeguards, accountability mechanisms, and deep-rooted institutional credibility. Its regulatory culture underscores that the long-term sustainability of digital systems depends on public trust, ethical safeguards, and robust oversight frameworks.

Together, these models offer a compelling synthesis: scale ensures reach and inclusion, while trust ensures durability and legitimacy. The convergence of these strengths provides a foundation for a balanced and sustainable digital partnership.

Digital Infrastructure and Data as Geopolitical Frontlines

Semiconductors, cloud infrastructure, data centres, undersea cables, and AI ecosystems have become central pillars of economic security. However, these assets are increasingly vulnerable to geopolitical disruption, cyber threats, and supply-chain fragmentation, which underscores the need for coordinated resilience strategies.

Data governance is seen as a critical domain of convergence. Both countries endorse the principle of 'Data Free Flow with Trust' (DFFT). At the same time, India's emphasis on data sovereignty,

equitable access, and strategic autonomy reflects a cautious approach toward unrestricted cross-border data flows. This suggests that calibrated bilateral or regional arrangements, rather than expansive multilateral commitments, may provide a more feasible pathway to building trust and reciprocity.

Technology governance has thus become an extension of geopolitical competition. Standards-setting, AI regulation, and platform governance increasingly shape global power dynamics, transforming regulatory coordination into a core instrument of diplomacy.

Evolving Partnership: Capabilities, Vulnerabilities, Coalitions

India-Japan digital engagement is transitioning from project-based cooperation to a more strategic partnership with regional implications. Collaboration in semiconductors, cybersecurity, and digital public infrastructure has the potential to strengthen technological sovereignty and systemic resilience.

The complementarities are evident: India's deep talent pool and software capabilities align with Japan's strengths in advanced manufacturing, hardware engineering, and process discipline. Together, they can support end-to-end value chains spanning design, fabrication, deployment, and lifecycle management.

However, structural vulnerabilities persist. Hardware dependencies, including limited fabrication capacity and supply concentration, remain significant. Software ecosystems are often shaped by external standards and dominant global platforms. Regulatory asymmetries and differing risk perceptions further complicate integration.

India's success in deploying inclusive digital infrastructure has enhanced its credibility across the Global South. Combined with Japan's financial resources and technical expertise, this creates opportunities for coordinated third-country engagement. Nonetheless, regulatory misalignment, cultural differences, and protracted legal harmonization, particularly in cybersecurity and data governance, remain enduring challenges. As digital technologies increasingly shape foreign policy, new institutional frameworks for sustained collaboration will be required.

From Diversity to Coalition Realities

Divergent digital models should be viewed as strategic assets rather than as obstacles. Digital infrastructure is now inseparable from national security considerations, making it imperative to have joint approaches to supply-chain resilience and cybersecurity.

Data governance has become central to digital geopolitics, with bilateral and minilateral arrangements often advancing more rapidly than broad multilateral frameworks. Ecosystems that are anchored in shared standards and interoperable regulatory frameworks increasingly carry as much strategic influence as formal alliances.

Gaps in interoperability, however, remain a persistent constraint. Technological innovation frequently outpaces regulatory adaptation, creating a policy lag. Coalition-building is essential but it is complex, and requires a careful balancing of shared principles with national interests.

Building End-to-End Digital Value Chains

Both countries would benefit from pursuing integrated value-chain strategies, particularly in semiconductors and advanced electronics. Coordinated planning across design, fabrication, testing, packaging, and raw-material sourcing would enhance supply-chain resilience.

Joint investments in secure cloud infrastructure and regionally distributed data centres could mitigate geopolitical risks. Such initiatives would support sovereign digital stacks that combine India's scalability with Japan's emphasis on quality and security to enable applications ranging from AI development to secure-edge computing.

Advancing Trusted Data Flows and Regulatory Convergence

Gradual, sector-specific pilot initiatives in fintech, healthcare, and smart cities could operationalise trusted data flows while safeguarding sovereignty concerns. Progressive alignment of data protection frameworks and AI governance principles would support mutual recognition over time.

A phased approach, beginning with non-sensitive or anonymised data applications, could offer a pragmatic pathway to building confidence and reciprocity, thereby avoiding multilateral deadlock.

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"Technology platforms are no longer neutral infrastructure. They are now central to geopolitical negotiation. The AI race will redefine national power, and it demands an entirely new strategic framework."

Extending Impact Across the Indo-Pacific and Global South

India and Japan can jointly advance digital public infrastructure initiatives across Southeast Asia, the Indian Ocean Region, and parts of Africa. Collaborative promotion of interoperable standards for digital identity, payments, and cybersecurity would strengthen regional resilience.

By combining India's experience in delivering cost-effective, inclusive digital systems with Japan's financial and technical capabilities, the two countries can contribute to open and secure digital ecosystems in third countries.

Regulatory Bridging, Resilience, and Norm-shaping

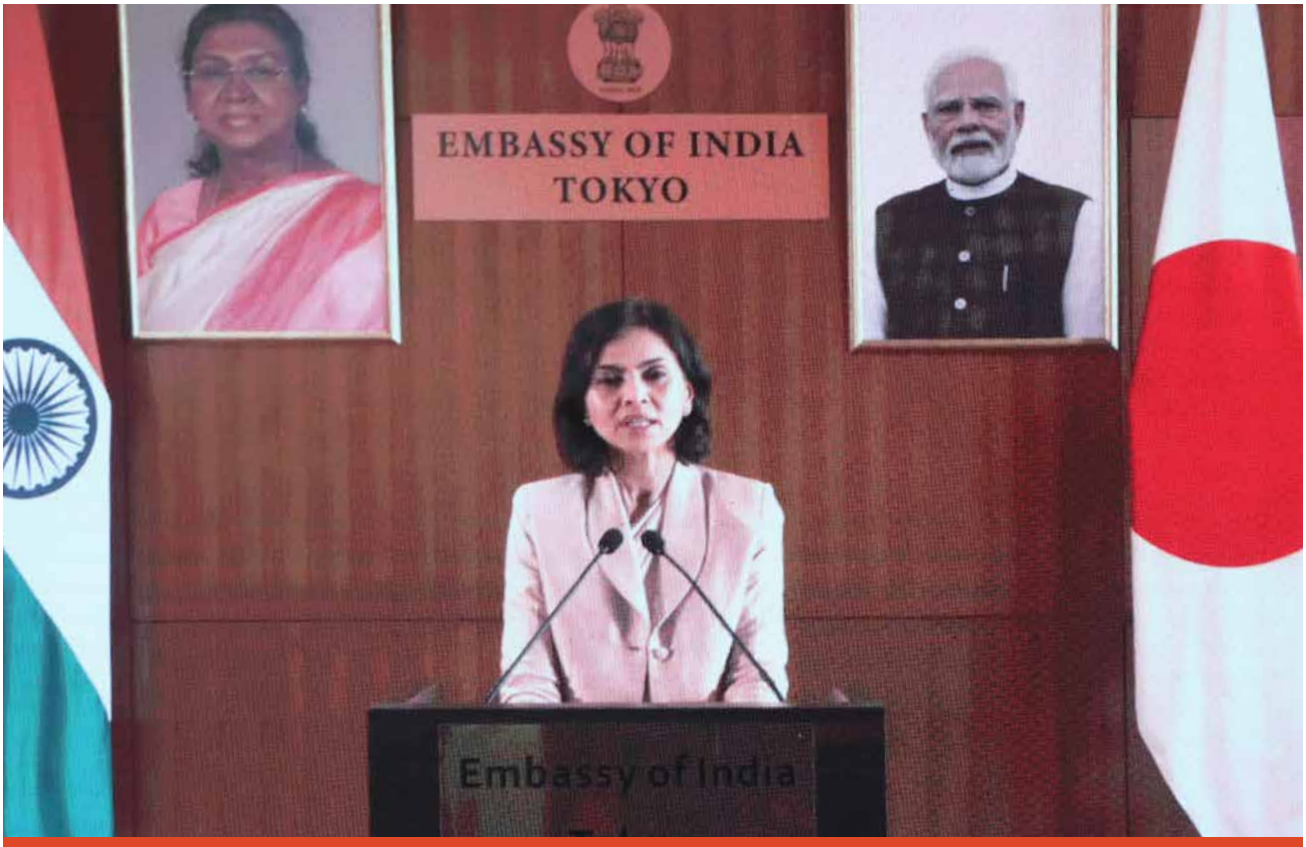
Bridging regulatory gaps will require phased mutual recognition arrangements, including cross-border validation of digital credentials and enhanced cybersecurity coordination. Regular joint exercises simulating cyber disruptions and infrastructure shocks could further strengthen preparedness.

At the international level, coordinated engagement in global standards-setting forums would enable both countries to advocate open, secure, and trust-based digital governance models. Expanded trilateral cooperation with like-minded partners could amplify normative influence and reinforce shared principles in global digital governance.

Conclusion

India and Japan are no longer limited to discrete digital collaboration; they are emerging as co-architects of the Indo-Pacific digital order. Anchored in complementary strengths of scale and trust, their partnership offers a pathway toward reimagining digital infrastructure, data governance, and technological sovereignty in the twenty-first century.

The principal challenge is not conceptual alignment but institutional execution. Sustained, structured, and forward-looking cooperation will determine whether this partnership can evolve from strategic potential to systemic impact.



Nagma Mallick, Ambassador of India to Japan

CHAPTER 4

PASSPORTS OF POTENTIAL: THE FUTURE IN HUMAN CAPITAL

Introduction

Human capital cooperation is an underutilised pillar of the India-Japan partnership. As bilateral relations have traditionally focused on infrastructure, manufacturing, and strategic cooperation, people-to-people mobility, especially in education, skills, and labour markets, has lagged behind its potential.

The panel discussion on India-Japan human capital futures highlighted a structural paradox. Japan faces acute demographic decline and labour shortages, while India possesses a vast demographic dividend and surplus skilled workforce. Despite this natural complementarity, Indian participation in Japan's education and labour ecosystems remains limited compared to other Asian countries.

This chapter analyzes the structural drivers, institutional constraints, and strategic opportunities shaping the India-Japan human capital cooperation. It argues that transforming human capital mobility from a peripheral concern into a strategic partnership pillar is essential for sustaining the broader relationship in the coming decades.

Demographic Powerhouse: India's Youth Fuelling Japan's Future

A central structural driver of deeper India-Japan cooperation lies in the demographic asymmetry between the two countries.

Japan is faced with a sustained decline in population, rapid ageing, and acute labour shortages across critical sectors including advanced manufacturing, elder care, construction, and high-technology industries. In contrast, India is in a phase of demographic advantage, characterised by a large and expanding working-age population with rising educational attainment and strong aspirations for global mobility.

This divergence presents a strategic opportunity for structured labour mobility partnerships, skills-alignment frameworks, and institutionalised talent pathways that can channel India's demographic dividend into Japan's innovation ecosystem. Carefully designed cooperation spanning language training, technical certification harmonization, digital skilling, and sector-specific mobility agreements could reinforce Japan's productivity and industrial competitiveness while generating high-quality employment and human-capital upgrades for India.

Sectors such as robotics, healthcare services, semiconductor manufacturing, and green industrial production offer immediate scope for such collaboration, provided both governments embed mobility within the broader frameworks of social integration, standards recognition, and long-term workforce planning.

Barriers of Awareness, Language, and Integration

Remarkably few Indians, whether students eyeing leading universities or professionals seeking careers, are aware of Japan's offerings, including world-class institutions, affordable degree programs, and reliable post-graduation employment pathways. Japan remains off the radar as American and British destinations dominate.

Barriers of language, requirements of cultural immersion, and demands of settling in a new

society require robust support systems including language-training, community networks, family support, and anti-bias measures. Challenges on Japan's side of the equation include slow university onboarding processes, complex visa procedures, and administrative inertia that erode competitiveness and allow rival countries to capture talent.

Industry provides instructive models for faster progress. Firms such as Suzuki and Panasonic have, through joint ventures and apprenticeship programs, demonstrated how corporate initiative can bridge cultural and skills divides more quickly than ministerial coordination alone, offering blueprints for broader people-to-people linkages.

Human Capital: The New Anchor of Enduring Ties

Historically tilted toward capital-intensive infrastructure and manufacturing, the partnership's long-term viability now rests on fluid human flows. To endure, technology transfers and industrial development need human foundations.

India's actual participation falls far short of potential: Indians continue to be held back by patchy information, cumbersome policies, and operational silos in India's Ministry of External Affairs and Japan's Ministry of Foreign Affairs. Countries of Southeast Asia and Nepal dominate the flow thanks to cultural proximity, linguistic affinities, and well-greased institutional pathways as India's volume advantage lies largely idle.

Mobility is about more than economics. Its human aspects encompass family wellbeing, cultural harmony, spousal career opportunities, and inclusive workplaces that determine whether talent stays or leaves. At a broader level, a well-functioning talent axis reinforces supply chains, amplifies technology ecosystems, and increases Indo-Pacific influence, weaving tighter bilateral bonds with regional strategic heft.

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"There are just 1,400 Indian students studying in Japan today compared to over 130,000 Chinese students. The opportunity is overwhelmingly compelling. The challenge is not supply; it is awareness and coordination."

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Core Lessons: From Promise to Practical Pathways

Demographic complementarity does not automatically translate into talent flows; dedicated mechanisms are required to unlock it. Awareness deficits demand targeted campaigns as urgently as legal or regulatory reform. Language and culture are not peripheral add-ons; they are make-or-break factors that require sustained public investment in training ecosystems.

The agility of industry outpaces the processes of state. Corporate models of fast-tracking integration should be studied and replicated. Holistic policies are essential – employment, education, and social support must be synchronized for genuine retention. Beyond the bilateral benefits, mobility strengthens the bedrock of trust that sustains the partnership through turbulent times.

Forging a Human Capital Partnership Agreement

At the India-Japan Annual Summit in 2025, the two Prime Ministers concurred on a two-way exchange target of 500,000 people over five years, including 50,000 skilled personnel.

Building on this political commitment, a bilateral human capital partnership agreement seeks to knit together education exchanges, skills-building programs, streamlined migration pathways, and smooth integration support under a single umbrella framework that rallies government ministries including India's MEA and MeitY and Japan's MEXT and MOFA around synced goals and measurable outcomes.

Scaling Language and Cultural Bridges

The core barriers must be addressed head-on. Rolling out joint India-Japan language institutes in hubs such as Delhi, Bengaluru, Mumbai, Chennai, and Kolkata, offering immersive Japanese language courses tied to job placement pathways, would provide the foundational infrastructure. Integrating Japanese language learning into India's vocational training ecosystem through ITIs and polytechnics, with industry partners like Toyota providing practical modules, would deepen reach. Digital tools including AI-powered tutors and virtual reality cultural simulations can achieve mass scale, with an aim to reach a million learners annually.

Streamlining Pipelines for Students and Workers

Red tape must be reduced significantly. Fast-tracking university admissions with dedicated quotas and one-stop visa portals for Indian applicants, and cutting processing times from months to weeks, would be transformative. Mutual qualification recognition – making Indian

engineering degrees valid in Japan and Japanese certifications recognised in India – would ease transitions for professionals. Sector-specific pipelines in healthcare, manufacturing, logistics, and IT, with pre-vetted training-to-job pathways managed through chambers such as FICCI and Keidanren, would bring scale and structure.

Powering Up Industry-Government Synergies

Private sector muscle must be engaged. Japanese companies operating in India should be encouraged to become talent incubators through on-site Japanese language training, mentorship programs, and Japan-based rotations. Forging public-private partnerships where governments fund foundational capabilities such as language training and safety standards while firms handle placements and incentive structures, including tax breaks for companies building training pipelines, can help scale up proven models.

Elevating Talent as Indo-Pacific Strategic Glue

Human capital and mobility should be embedded in core bilateral summits, including the 2+2 dialogues, as a pillar alongside security and economic cooperation. Extending this outward – co-training Southeast Asians and other Indo-Pacific partners in India-Japan hubs, exporting blended skills for regional supply chains through trilateral programs such as IT bootcamps with Vietnam or nursing initiatives for Pacific island nations – would amplify joint influence while addressing shared demographic challenges.

Conclusion

India-Japan human capital cooperation is not merely a labour market adjustment; it is a strategic transformation of bilateral relations. By institutionalizing talent mobility, India and Japan can redefine their partnership from one driven by capital and technology to one sustained by people, skills, and shared societal futures.


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CHAPTER 5

CAPITAL CURRENTS: SHAPING THE TRADE AND INVESTMENT TIDE

Introduction

Economic relations between India and Japan have evolved from a commercially grounded engagement into a multidimensional strategic partnership shaped by geopolitical alignment, technological interdependence, and supply-chain resilience imperatives.

The relationship rests on deep historical foundations: Japanese firms have operated in India for more than a century, and institutional economic cooperation was significantly strengthened with the signing of the Comprehensive Economic Partnership Agreement (CEPA) in 2011. CEPA liberalised trade in goods and services, improved investment protections, and created formal mechanisms for regulatory dialogue.

Japan has consistently ranked among India's largest sources of Official Development Assistance (ODA). It is also a leading source of cumulative Foreign Direct Investment in India, with major concentrations in automobiles, electronics, chemicals, and financial services.

Despite these structural foundations and strong political alignment under the Special Strategic and Global Partnership framework, bilateral trade and investment flows remain below potential. Japan accounts for a modest share of India's total trade, and Japanese FDI into India trails its engagement with ASEAN economies such as Vietnam and Thailand.

This paradox of deep strategic convergence but limited economic scale constitutes a central structural challenge in the bilateral relationship.

This chapter examines the drivers, constraints, and emerging opportunities shaping India-Japan trade and investment relations. It argues that the next phase of the partnership will depend less on incremental capital inflows and more on systemic integration: supply-chain embedding, regulatory harmonization, SME connectivity, and coordinated industrial strategy in critical sectors.

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"The challenge is not at the level of policy intent. It lies in regulatory execution and ground-level implementation. That is where investor confidence is tested."

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Japanese Roots Run Deep: Ecosystems Over Transactions

Japanese firms have historically adopted a long-horizon approach in India, prioritizing ecosystem development over short-term returns. The most illustrative example is the automotive sector, anchored by Maruti Suzuki, which catalyzed not merely vehicle production but the creation of a dense supplier ecosystem, technology-transfer networks, and quality-control systems rooted in Japanese manufacturing philosophy.

The diffusion of production practices such as kaizen, lean management, and just-in-time systems contributed to productivity upgrades among Indian suppliers. Over time, this model generated localised value chains, skill formation, and export capabilities.

Japanese industrial townships in states such as Gujarat, Tamil Nadu, and Rajasthan reflect this ecosystem approach, integrating logistics, vendor parks, training institutes, and long-term supplier relationships.

The 'ecosystem over transaction' model offers a template for deeper bilateral integration. However, its replication beyond automobiles into electronics, precision manufacturing, green technologies, and advanced materials has been slower than anticipated.

Intent-Outcomes Mismatch: Structural Bottlenecks

Political alignment between New Delhi and Tokyo has rarely been stronger. Both governments emphasize shared democratic values, Indo-Pacific stability, and supply-chain diversification. However, economic outcomes lag behind strategic rhetoric.

Key structural bottlenecks include regulatory complexity and procedural unpredictability across central and state levels; land acquisition and infrastructure challenges that increase project gestation periods; policy volatility in areas such as tariffs, standards, and localization rules; limited dispute-resolution efficiency; and high compliance costs that disproportionately affect SMEs.

Japanese firms, particularly SMEs, prioritize regulatory stability, long-term predictability, and incremental scaling. Sudden policy shifts or compliance ambiguities disproportionately discourage their entry.

Cultural operating differences between Japan's consensus-driven and risk-averse corporate governance structures and India's more flexible and improvisational business environment can compound these frictions. Bridging this gap requires institutionalized mechanisms for pre-policy consultations, regulatory transparency, and structured grievance redressal.

Supply Chains, SMEs, and Economic Security

The global reconfiguration of supply chains, accelerated by pandemic disruptions, US-China strategic competition, and resource nationalism, has elevated economic security to the forefront of policy planning. India and Japan share convergent interests in diversifying supply chains in critical sectors including semiconductors, electric vehicles, rare earths, batteries, and renewable energy components.

Japan's strengths lie in advanced materials, precision manufacturing, robotics, and process engineering. India offers scale, growing domestic demand, an expanding manufacturing base under PLI schemes, and access to critical mineral resources through third-country partnerships.

However, value chains remain insufficiently integrated. Japanese large corporations often treat India as a market destination rather than as an export-oriented production base embedded within regional supply networks.

SMEs represent a pivotal but underleveraged component. In Japan, SMEs account for the overwhelming majority of enterprises and form the backbone of industrial supply chains. Yet, Japanese SME penetration in India remains limited due to financing constraints, limited information access, and regulatory complexity.

Without SME integration, bilateral trade will remain top-heavy and shallow, lacking the dense supplier ecosystems necessary for resilient manufacturing.

Comparative Underperformance: ASEAN as Benchmark

Japan's investment footprint in ASEAN economies significantly exceeds its engagement with India. Countries such as Vietnam, Thailand, and Indonesia offer streamlined regulatory processes, integrated industrial zones, and deep participation in regional trade agreements such as the Regional Comprehensive Economic Partnership (RCEP).

India's withdrawal from RCEP created gaps in both policy autonomy and trade integration. Meanwhile, ASEAN's export-oriented manufacturing ecosystems have positioned these countries as preferred supply-chain destinations.

However, the structural dynamics are shifting. India's sustained GDP growth trajectory and expanding domestic market are recalibrating investor perceptions. As India approaches upper-middle-income thresholds and scales its manufacturing ambitions, its role may shift from peripheral market to central production node in Indo-Pacific supply chains.

For Japan, adapting to India's economic ascent requires strategic repositioning – from viewing India primarily as a consumption market to treating it as a co-production and co-innovation hub.

Conclusion

The India-Japan economic partnership is at a structural inflection point. Political trust and strategic alignment provide a strong foundation, yet economic integration remains shallower than its potential.

The challenge is not intent but execution: closing regulatory gaps, embedding SMEs, and constructing integrated supply chains in high-technology and strategic sectors.

The next phase must move beyond transactional trade flows toward systemic production integration. If India and Japan can align regulatory frameworks, industrial policies, and economic security strategies, they will not only deepen bilateral ties but also jointly shape the evolving economic architecture of the Indo-Pacific.


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CHAPTER 6

STRATEGIC CONVERGENCE: INDIA-JAPAN SEMICONDUCTOR COOPERATION

Introduction

The evolving trajectory of India-Japan cooperation in semiconductors reflects an ongoing broader reconfiguration of the global political economy of technology.

Once treated primarily as a commercial commodity governed by market forces and incremental innovation cycles, semiconductors have emerged as a foundational element of national power, economic resilience, and geopolitical leverage. This transformation has altered the strategic calculus of states, elevated government involvement in industrial planning, and reshaped patterns of international cooperation.

Against this backdrop, India and Japan find themselves increasingly aligned, not merely as economic partners, but as strategic collaborators seeking to construct resilient, secure, and trusted technology ecosystems that are capable of withstanding systemic disruption.

This chapter explores the conceptual, strategic, industrial, financial, and geopolitical dimensions of India-Japan semiconductor cooperation, situating it within the wider context of global supply-chain restructuring, technological competition, and emerging frameworks of economic security.

It argues that semiconductor collaboration is no longer a niche industrial undertaking but constitutes a central pillar of bilateral strategic engagement. Through an examination of industrial policy evolution, corporate engagement, supply-chain vulnerabilities, talent development, financial architecture, and geopolitical alignment, India and Japan are collectively engaged in shaping a new model of technology partnership designed to enhance resilience, sovereignty, and long-term competitiveness.

At its core, semiconductor cooperation between India and Japan is driven by a convergence of necessity and opportunity.

Both nations are confronted with mounting vulnerabilities in globally fragmented supply chains that are increasingly exposed to geopolitical shocks, natural disasters, trade restrictions, and strategic coercion. At the same time, the accelerating demand for digital technologies, AI, advanced manufacturing, electric mobility, telecommunications, and defence modernization creates unprecedented incentives to invest in domestic and allied semiconductor ecosystems.

Covid-19 pandemic: The Trigger and the Lessons

The pandemic-induced supply disruptions of 2020-2022 made the world acutely aware of its critical semiconductor dependence. Factory shutdowns in East Asia, coupled with a surging demand for consumer electronics, automotive systems, medical devices, and cloud infrastructure, triggered widespread shortages that cascaded across multiple sectors. For policymakers in both India and Japan, the crisis underscored the risks inherent in excessive reliance on geographically concentrated manufacturing hubs and complex, opaque supplier networks. The lesson was unmistakable: semiconductor resilience had become synonymous with economic security.

Japan had a legacy of deep technological expertise in materials science, equipment manufacturing, and precision engineering. Decades of sustained investment had positioned Japanese firms at critical nodes of the semiconductor value chain, particularly in photoresists, silicon wafers, specialty chemicals, deposition equipment, and process control systems. Despite losing ground in advanced logic fabrication to competitors in Taiwan and South Korea, Japan

retained irreplaceable dominance in upstream technologies.

India on the other hand possessed world-class capabilities in semiconductor design, software engineering, and digital systems architecture, but lacked meaningful domestic fabrication capacity. This asymmetry offered both a challenge and an opportunity: the challenge lay in bridging the manufacturing gap, while the opportunity emerged in combining complementary strengths to create a vertically integrated, strategically aligned partnership.

India's policy response was the establishment of the India Semiconductor Mission, a comprehensive framework designed to catalyze domestic manufacturing, attract foreign investment, and nurture local ecosystems. To begin with, fabrication plants, assembly and testing facilities, and design-linked incentives were prioritized, along with unprecedented fiscal commitments. For the first time, India sought to not merely participate in global semiconductor supply chains, but to anchor significant segments of them domestically. This was a radical departure from earlier industrial strategies that had focused largely on software and services.

Japan carried out its own transformative industrial recalibration. Confronted with growing geopolitical uncertainty and intensifying technological competition, Tokyo initiated a strategic reorientation toward economic security, involving substantial public investment in fabrication facilities, international technology partnerships, and regulatory frameworks designed to protect critical industries.

The enactment of the Economic Security Promotion Act institutionalized these priorities, embedding supply-chain resilience, strategic technology protection, and industrial competitiveness into Japan's national security architecture. Within this framework, international partnerships, particularly with countries capable of offering scale, talent, and long-term market potential, assumed greater importance.

The India-Japan semiconductor cooperation must be understood in the context of this dual transformation.

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Rather than a conventional investment partnership, it represents an attempt to construct a strategic industrial alliance grounded in mutual dependence, trust, and long-term convergence.

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Strategic Pillars of Cooperation

Semiconductor cooperation between India and Japan rests on several interlocking pillars: diversification of supply chains, joint ecosystem development, technological co-creation, workforce mobility, financial integration, and geopolitical alignment.

Supply-chain diversification is the most immediate driver. Global semiconductor production remains heavily concentrated in a narrow set of geographies – particularly Taiwan, South Korea, and increasingly China – which exposes downstream industries worldwide to disruptions arising out of geopolitical tensions, natural disasters, disease outbreaks, or regulatory interventions. Bilateral cooperation between India and Japan offers a pathway to distribute production risks, establish alternative manufacturing corridors, and create redundancy across critical stages of chip production.

Diversification must be complemented by comprehensive visibility in supply-chain architectures. Multi-tiered semiconductor supply networks are inherently opaque. A single advanced chip may incorporate thousands of components sourced from dozens of countries, each governed by distinct regulatory regimes. India and Japan have recognized the imperative of developing joint supply-chain mapping initiatives capable of identifying chokepoints, bottlenecks, and single-source dependencies before they manifest as systemic crises.

These vulnerabilities extend beyond fabrication. They encompass critical raw materials: specialty gases, photoresists, precision tools, and advanced packaging technologies. Rare earth elements, gallium, germanium, high-purity silicon, and advanced polymers, all represent strategic inputs that are susceptible to geopolitical manipulation. India's efforts to develop critical minerals strategies intersect with Japan's longstanding expertise in materials science and resource diplomacy, offering significant scope for coordinated approaches to sourcing, stockpiling, recycling, and substitution.

Intellectual Property, Workforce, Corporate Engagement

Protection of intellectual property and technology governance are key dimensions of semiconductor cooperation. Japanese firms that have invested

vast resources in R&D are understandably cautious about technology-sharing. Concerns over IP leakage, regulatory unpredictability, and insufficient legal enforcement have historically constrained deeper industrial partnerships in emerging markets.

Recent legal and regulatory reforms in India, alongside improvements in contract enforcement, data protection, and corporate governance, have begun to mitigate these concerns. Nonetheless, trust-building remains a gradual process that requires consistent policy signalling, institutional reliability, and operational transparency.

From India's perspective, absorbing advanced manufacturing technologies necessitates parallel investments in human capital. Semiconductor fabrication and advanced packaging are among the most complex of industrial processes, which demand not only specialized technical skills but also rigorous process discipline and quality-control cultures.

India boasts one of the world's largest engineering talent pools, but has limited experience in high-volume semiconductor manufacturing. Bridging this gap requires systematic workforce development, including international training programs, joint academic curricula, industry apprenticeships, and cross-border talent mobility frameworks. Japan's manufacturing ethos, characterised by meticulous attention to detail, continuous improvement, and deep integration between shop-floor operations and engineering design, provides an invaluable model for workforce development.

Corporate engagement constitutes another cornerstone of bilateral semiconductor cooperation. Japanese firms occupy commanding positions across materials, equipment, and process technologies within the semiconductor value chain. Their integration into India's emerging semiconductor ecosystem can potentially catalyze rapid industrial maturation.

Early investments by Japanese materials and equipment manufacturers signal growing confidence in India's industrial trajectory. These ventures reflect strategic calculations aimed at embedding within India's manufacturing ecosystem, cultivating local supplier networks, and participating in long-term industrial growth.

For Indian firms, partnership with Japanese corporations offers access to advanced technologies, global quality standards, and international market linkages.

Financial Architecture and Geopolitical Dimensions

Financial architecture plays a critical enabling role.

Semiconductor manufacturing is among the most capital-intensive industries globally. Fabrication plants often require investments of several billions of dollars. Gestation periods are long, demand cycles are uncertain, and there is a high risk of rapid technological obsolescence. As such, traditional commercial financing models are frequently ill-suited to such risk profiles.

Japan has mobilized state-backed financial instruments to support strategic industrial investments abroad, with the Japan Bank for International Cooperation (JBIC) and JICA emerging as pivotal actors, deploying long-term financing mechanisms designed to advance Japan's economic security objectives while supporting allied industrial development.

For India, access to such patient capital is indispensable. Japanese financial participation not only augments available capital but also enhances project credibility, thereby crowding in private investment. Structured financial cooperation can facilitate risk-sharing, currency stabilization, and long-term operational sustainability.

The geopolitical dimension cannot be overstated.

The intensification of strategic competition between major powers has transformed technology into a primary arena of contestation. Export controls, investment screening mechanisms, technology blacklists, and industrial subsidies have become instruments of statecraft.

In this environment, countries face increasing pressure to align their technological ecosystems with trusted partners. India and Japan, both committed to a like-minded international order, technological openness, and democratic governance, share a natural affinity in this context. Their cooperation aligns closely with broader Indo-Pacific strategic frameworks that emphasize resilience, diversification, and multilateral engagement. Semiconductor collaboration thus becomes not merely a bilateral undertaking but a component of a wider strategic architecture aimed at preserving technological openness while mitigating coercive dependencies.

Infrastructure, Innovation, and the Path Ahead

Infrastructure development represents another critical dimension.

Semiconductor fabrication facilities demand not only reliable power and water supplies, but also sophisticated logistics networks, waste management systems, cleanroom-grade industrial environments, and advanced urban infrastructure capable of supporting highly skilled workforces. India's emerging semiconductor hubs, particularly in Gujarat and Assam, illustrate both the opportunities and challenges inherent in such large-scale industrial transformation.

Rapid infrastructure deployment must be accompanied by social development initiatives including housing, healthcare, education, and urban amenities to attract and retain global talent. Japanese experience in industrial cluster development, where manufacturing zones are integrated with residential, educational, and commercial infrastructure, offers valuable insights in this regard.

The innovation dimension of semiconductor cooperation extends beyond manufacturing into research and development (R&D).

Next-generation technologies, including advanced node fabrication, heterogeneous integration, chiplet architectures, and three-dimensional packaging, demand sustained collaborative research efforts. Joint R&D initiatives between Indian and Japanese universities, research institutes, and corporate laboratories could accelerate technological breakthroughs while cultivating shared intellectual capital.

Education and academic exchange form the bedrock of this innovation ecosystem. Long-term cooperation requires cultivating shared epistemic communities capable of bridging cultural, linguistic, and institutional divides. Student exchanges, collaborative research programs, and faculty mobility can, over time, produce professional networks that reinforce trust and strategic alignment.

While the momentum behind India-Japan semiconductor cooperation is considerable, numerous challenges remain.

Technological complexity, capital intensity, regulatory inertia, infrastructure bottlenecks, and workforce shortages pose formidable obstacles. Navigating these challenges requires not only financial resources but also institutional agility, policy coherence, and strategic patience. Trust remains the lynchpin of successful cooperation, an incremental process shaped by consistent engagement, transparent governance, and equitable benefit-sharing.

Conclusion

India-Japan semiconductor cooperation stands at the intersection of industrial policy, geopolitical strategy, and technological innovation. It reflects a shared recognition that the challenges of the twenty-first century demand collective responses anchored in mutual trust and strategic foresight.

While the path ahead is complex and fraught with uncertainty, the foundations being laid today carry the potential to reshape both bilateral relations as well as the global semiconductor landscape. Through sustained engagement, institutional innovation, and strategic alignment, India and Japan are building together an architecture of trusted technology supply chains capable of supporting long-term economic prosperity, technological leadership, and geopolitical stability.


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CHAPTER 7
SUPPLY CHAINS AS STRATEGIC INFRASTRUCTURE

Introduction

The transformation of global supply chains over the past decade has fundamentally altered the relationship between economics, technology, and geopolitics.

Once primarily optimized for cost efficiency, scale, and speed, supply chains are now increasingly understood as strategic enablers of national security, economic stability, and technological sovereignty. For India and Japan, two major Indo-Pacific economies navigating an era of intensifying great-power competition and systemic economic fragmentation, supply-chain resilience has become a core pillar of national strategy.

Multiple shocks have produced the erosion of trust in hyper-globalised production networks concentrated in small geographies.

The US-China trade war showed how tariffs and export controls could rapidly weaponize interdependence. The Covid-19 pandemic demonstrated how logistical bottlenecks and factory shutdowns could cascade through tightly coupled production systems, bringing entire industries to a halt. Russia's invasion of Ukraine and the subsequent sanctions regime illustrated how energy, food, fertilizers, and strategic minerals could be transformed into instruments of coercion. All these disruptions exposed a structural fragility at the heart of the existing globalization model.

The response from policymakers has been to reframe supply chains not merely as commercial systems but as components of national security architecture. Resilience, redundancy, diversification, and trusted connectivity have emerged as guiding principles. Rather than seeking full autarky, which would be economically inefficient and technologically regressive, states have aimed to reduce single-point dependencies, build domestic capacity in critical sectors, and deepen cooperation with politically aligned partners.

India and Japan occupy complementary positions within this evolving landscape. India offers scale, demographic advantage, expanding domestic demand, and growing manufacturing ambition. Japan brings advanced industrial capabilities, technological sophistication, managerial expertise, and deep experience in global production networks. Together, they possess the potential to co-create resilient, technologically advanced, and geopolitically secure supply chains that serve not only bilateral interests but also the broader Indo-Pacific economic order.

This chapter examines how India-Japan cooperation can be structured to enhance supply-chain resilience across strategic sectors. It focuses on steel and automotive manufacturing, semiconductors and electronics, green hydrogen and ammonia, electric mobility, SME integration, digital interoperability, industrial clustering, standards alignment, financing mechanisms, workforce development, and third-country collaboration.

From Global Efficiency to Strategic Resilience

For almost four decades, global supply chains were shaped by the logic of comparative advantage, scale economies, and just-in-time production. China's rise as the world's manufacturing hub reflected this paradigm: dense supplier networks, efficient ports, disciplined labour, and state-supported infrastructure enabled unprecedented scale efficiencies. By the late 2010s, China accounted for close to a third of the global manufacturing output, while East Asia dominated electronics, machinery, and intermediate goods.

But this hyper-concentration produced systemic vulnerabilities. Just-in-time logistics minimized buffers, leaving little room for error. Geographical concentration created single points of failure.

Political frictions introduced strategic risk into what had previously been treated as purely commercial decisions. As geopolitical competition intensified, export controls, sanctions, and industrial policy instruments became tools of statecraft, exposing firms to sudden regulatory shocks.

The semiconductor shortage of 2020-2022 offered a particularly stark example. Temporary disruptions in Taiwanese and Korean fabrication plants led to global automotive shutdowns, highlighting how deeply integrated and fragile production networks had become. Similar dynamics were seen in pharmaceuticals, rare earths, personal protective equipment, and telecommunications hardware. These episodes catalyzed a rethinking of supply chain design across governments and boardrooms alike.

Strategic resilience now emphasizes diversification across multiple geographies, the development of domestic manufacturing capacity in sensitive sectors, and the construction of trusted networks among politically aligned economies. India-Japan cooperation aligns closely with this paradigm: both countries seek to preserve the efficiency gains of globalization while embedding safeguards against coercion, disruption, and systemic collapse.

Strategic Foundations of India-Japan Cooperation

India and Japan share a broad alignment in their strategic outlook on the Indo-Pacific. Both are committed to a rules-based international order, freedom of navigation, and open economic systems. Both are wary of excessive dependence on China-centric production networks, particularly in sectors with security implications. And both increasingly view economic security as inseparable from national security.

This convergence is institutionalized through multiple frameworks.

The Annual Summit mechanism provides political guidance. CEPA establishes the legal architecture for trade and investment flows. The Quadrilateral Security Dialogue (Quad) embeds economic security within a broader strategic partnership alongside the United States and Australia. The Supply Chain Resilience Initiative provides a trilateral platform for diversification and coordination. Sector-specific dialogues on semiconductors, digital trade, energy, and industrial standards further operationalize cooperation.

Despite this dense institutional web, operational coordination remains uneven. Fragmented regulatory frameworks, limited data interoperability, bureaucratic complexity, and infrastructure gaps continue to constrain the scale and speed of integration. Addressing these bottlenecks requires sustained political clarity, institutional reform, and private-sector engagement.

Steel and Automotive Manufacturing: Anchors of Industrial Integration

Steel remains the foundation of modern industrial economies, underpinning construction, infrastructure, transport, defence, and manufacturing. India's ambition to dramatically increase per capita steel consumption reflects its broader developmental trajectory. With accelerating urbanisation, expanding transport corridors, and rapidly scaling energy infrastructure, the demand for high-quality steel will rise sharply over the coming decade.

Japanese steel manufacturers bring unparallelled expertise in producing advanced, high-strength, and specialty steels. These materials enable lighter, stronger, and more durable products, particularly in the automotive sector. High-tensile steels allow for significant reduction of vehicle weights while maintaining structural integrity, which contributes to improved fuel efficiency, lower emissions, and enhanced safety. These capabilities are increasingly indispensable in an era of tightening environmental regulations.

The automotive sector serves as a critical interface between steel production, advanced materials, precision engineering, and export competitiveness. India's automotive output, currently around five million vehicles annually, is projected to approach nine million by 2030. Achieving this scale sustainably requires technological upgrades across the entire value chain, from metallurgy and stamping to electronics integration and software design.

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Japanese investment in Indian steel manufacturing, including joint ventures and greenfield projects, plays a vital role in localizing advanced materials production. Such localization reduces import dependence, shortens supply chains, and enhances responsiveness to domestic demand.

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The diffusion of rigorous quality-control systems, production-process optimization, and workforce training, all hallmarks of the Japanese manufacturing

philosophy, can over time embed high standards into Indian industrial practice, raising overall ecosystem competitiveness.

Policy coordination is essential. While India's industrial policy seeks to protect domestic manufacturing, selective openness is necessary for accessing specialized inputs that are unavailable locally. Carefully calibrated tariff regimes, streamlined import approvals for high-grade materials, and expedited customs procedures for critical components can preserve competitiveness without undermining domestic capacity-building.

Green Hydrogen and Ammonia: Energy Transition and Industrial Transformation

The transition to low-carbon energy systems is reshaping industrial strategy worldwide. Green hydrogen and green ammonia are emerging as critical vectors of decarbonization, particularly for heavy industry, shipping, power generation, and long-distance energy transport. Japan has invested heavily in hydrogen technologies and ammonia-based energy systems, while India is rapidly scaling renewable energy capacity and hydrogen production.

This complementarity creates significant opportunities for collaboration. Joint pilot projects can test hydrogen production, storage, transportation, and utilisation technologies under diverse climatic and infrastructural conditions. Scaling these pilots to industrial levels would allow India to become a major production hub while enabling Japan to secure long-term clean energy imports.

Beyond energy security, green hydrogen ecosystems stimulate industrial upgrading: electrolyzer manufacturing, power electronics, storage systems, and transport infrastructure all generate high-value manufacturing opportunities.

Policy alignment is essential to unlock these opportunities. Stable carbon pricing frameworks, guaranteed offtake agreements, blended finance instruments, and cross-border certification standards for green fuels will be required to attract large-scale private investment. Without such coordination, pilot initiatives risk remaining fragmented and commercially unviable.

Electronics, Electric Mobility, and Industrial Clustering

Electronics manufacturing is among the fastest-growing industrial sectors in India, driven by domestic demand, export ambition, and supportive policy frameworks. Japanese firms, with their strengths in precision components, sensors, imaging technologies, and power electronics, are well positioned to contribute to this expansion.

Electric mobility amplifies this opportunity. As India accelerates its transition toward electric vehicles, the demand for batteries, motors, power management systems, charging infrastructure, and thermal management solutions is rising sharply. Japanese expertise in battery chemistry, solid-state storage, automotive electronics, and quality assurance provides critical inputs for building globally competitive EV supply chains.

Resilient manufacturing depends not merely on individual investments but on the creation of dense industrial ecosystems. Clustering facilitates knowledge spillovers, reduces transaction costs, enables labour pooling, and accelerates the diffusion of innovation. Japanese industrial clusters in India, particularly in Chennai, Gujarat, and along the Delhi-Mumbai Industrial Corridor, demonstrate the advantages of co-location, fostering trust-based business relationships that lower coordination costs and improve operational efficiency.

Future cluster development should be strategically targeted: sector-specific clusters such as semiconductor hubs, green hydrogen corridors, or EV manufacturing zones can align infrastructure investment, regulatory facilitation, and workforce development around defined industrial objectives.

Digital Interoperability, Standards Harmonization, and Financing

As manufacturing becomes increasingly digitized, data flows emerge as critical enablers of efficiency, transparency, and resilience. Real-time inventory management, predictive logistics, quality monitoring, and production optimization rely on secure data exchange across organisational and national boundaries.

Establishing trusted data governance frameworks is, therefore, essential, combining common technical standards, encrypted transmission protocols, legal safeguards, institutional oversight, and dispute resolution mechanisms.

Differences in industrial standards, certification regimes, and regulatory frameworks constitute significant non-tariff barriers to deeper supply-chain integration.

India and Japan can pursue mutual recognition

agreements in areas such as automotive safety, electronics testing, environmental compliance, and industrial machinery certification. Joint standard-setting initiatives within international forums further amplify bilateral influence while shaping global norms.

Regulatory alignment also enhances investor confidence: predictable approval processes, transparent environmental assessments, and stable tax regimes reduce uncertainty and accelerate capital deployment.

Building resilient supply chains requires substantial capital investment.

Japan's development finance institutions, including JBIC and JICA, play a critical role in mobilizing patient capital for overseas industrial projects. Their collaboration with Indian financial institutions, sovereign funds, and multilateral development banks can create blended finance structures that de-risk private investment. Innovative instruments such as green bonds, transition finance, and public-private partnerships can further expand funding pools.

Workforce Development, SME Integration, and Third-Country Collaboration

Advanced manufacturing ecosystems depend on skilled labour, managerial expertise, and continuous training. India's demographic advantage provides a vast labour pool, while Japan faces acute skill shortages due to demographic ageing.

Bilateral workforce mobility, joint training institutes, vocational education partnerships, and digital skills platforms can address these complementary needs. Over time, such initiatives create transnational professional networks that sustain industrial cooperation beyond individual projects.

SMEs form the backbone of manufacturing ecosystems. Their integration into resilient supply chains enhances flexibility, innovation, and cost efficiency. Yet SMEs often face structural barriers including limited access to finance, technology, market intelligence, and skilled labour. Targeted interventions such as digital platforms connecting SMEs to major manufacturers, concessional credit, risk guarantees, and joint training programmes, can address these challenges while promoting inclusive industrial growth.

Beyond bilateral cooperation, India and Japan increasingly recognize the strategic value of joint ventures in third countries, particularly in Southeast Asia, the Pacific Islands, and East Africa.

Collaborative industrial projects in logistics, renewable energy, infrastructure, and manufacturing allow both countries to shape regional value chains while diversifying production risk. Such ventures also reinforce Indo-Pacific economic integration and expand strategic influence.

Conclusion

India-Japan cooperation on supply chain resilience reflects a strategic convergence shaped by geopolitical uncertainty, technological competition, and economic transformation. By aligning industrial policies, fostering manufacturing ecosystems, securing digital infrastructure, harmonizing standards, mobilising finance, and integrating SMEs, both nations can construct resilient, future-ready supply chains that balance efficiency with security.

Rather than retreating into economic nationalism, India and Japan are advancing a model of trusted connectivity anchored in openness, technological collaboration, and institutional alignment. Their partnership offers a blueprint for resilient globalisation — one that safeguards national interests while sustaining international economic integration and shared prosperity.


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CHAPTER 8

INDIA-JAPAN COOPERATION IN NUCLEAR ENERGY: ARCHITECTURE OF A NEW PARTNERSHIP

Introduction

The re-emergence of nuclear energy as a central pillar of national energy strategies represents one of the most consequential shifts in global energy policy over the past decade.

For much of the early twenty-first century, nuclear power was relegated to a contested and often politically sensitive domain, shaped by public apprehension, regulatory caution, and unresolved debates on safety, liability, and waste management. However, a confluence of technological advances, climate imperatives, geopolitical disruptions, and escalating energy demand has propelled nuclear energy back into the strategic mainstream.

Nowhere is this transformation more pronounced than in the evolving partnership between India and Japan. Nuclear cooperation, which was once constrained by historical legacies, regulatory complexities, and divergent domestic trajectories, has entered a phase of renewed political commitment, industrial ambition, and strategic convergence. The present moment is distinguished not merely by incremental policy reform, but by a structural rethinking of the role of nuclear energy in national development strategies, regional geopolitics, and global decarbonization pathways.

India's accelerating industrialisation, ambitious climate commitments, and unprecedented growth in electricity consumption have elevated nuclear energy from a supplementary source of baseload power to a strategic necessity.

Japan's recalibration of its post-Fukushima energy strategy, coupled with its enduring leadership in nuclear technology, materials, and precision manufacturing, positions it as a uniquely valuable partner in India's nuclear renaissance.

This chapter examines the drivers, dimensions, and implications of the India-Japan nuclear cooperation, and situates it within the broader transformations that are reshaping global energy governance, industrial policy, and technological geopolitics.

It traces the emergence of nuclear energy as a cornerstone of India's development strategy, assesses the opportunities and challenges associated with private-sector participation, and evaluates the strategic logic underpinning India-Japan collaboration. It argues that nuclear energy cooperation is no longer a narrow technical undertaking; rather, it constitutes a critical axis of bilateral strategic alignment, industrial modernisation, and long-term economic resilience.

Global Return of Nuclear Energy: Drivers of Strategic Revival

The global revival of nuclear energy is anchored in four interrelated transformations that have catalyzed renewed investment, regulatory reform, and international collaboration in this sector.

First, the post-Fukushima period has witnessed a gradual restoration of public confidence in nuclear safety, driven by technological advances, regulatory strengthening, and the accumulation of operational experience. Subsequent reassessments have demonstrated that modern reactor designs, enhanced safety protocols, and independent regulatory oversight significantly mitigate systemic risk. This has allowed policymakers to reconsider nuclear energy as a manageable and indispensable component of diversified energy systems.

Second, technological innovation has fundamentally altered the nuclear landscape. Advances in reactor design, digital instrumentation, materials engineering, and fuel-cycle management have enhanced safety margins, operational efficiency, and economic viability. Of particular significance is the emergence of small modular reactors and next-generation nuclear systems, which promise reduced capital intensity, faster construction timelines, enhanced safety features, and greater flexibility in deployment, thus enabling their application in industrial clusters, data centres, remote regions, and desalination facilities.

Third, the imperatives of climate mitigation have redefined the normative position of nuclear energy within global decarbonization strategies. As countries confront the scale of emissions reductions required to achieve net-zero targets, the limitations of renewable energy sources in providing stable baseload power have become increasingly evident. Intermittency, land-use constraints, storage limitations, and mineral supply dependencies constrain the ability of renewables to singularly anchor energy transitions, making nuclear energy a critical enabler of deep decarbonization.

Fourth, the digital transformation of the global economy has dramatically expanded electricity demand, particularly from data centres, AI systems, advanced manufacturing, and urban infrastructure. These energy-intensive sectors require uninterrupted, high-quality power, reinforcing the strategic value of nuclear baseload generation.

India's Energy Transition, Strategic Necessity of Nuclear Power

India's development trajectory places it at the epicentre of the global energy transition. As one of the fastest-growing major economies of the world, India faces the dual imperative of expanding energy access and industrial output while simultaneously reducing the carbon intensity of its growth. This challenge is magnified by demographic expansion, rapid urbanization, industrial modernization, and the digital transformation of services and manufacturing.

India's electricity consumption is projected to more than double over the next two decades, increasing from approximately 10,000 terawatt hours (TWh) to almost 25,000 TWh. While renewable energy has emerged as a central pillar of India's energy policy, its inherent intermittency and land requirements limit its capacity to singularly sustain this expansion. At the same time, the continued reliance on coal, which currently underpins the majority of India's baseload generation, poses severe environmental, public health, and climate risks.

Nuclear energy occupies a unique strategic position in this context: it is a scalable, low-carbon, high-density energy source that is capable of providing stable baseload power while supporting industrial growth.

India's longstanding commitment to nuclear development has enriched it with deep expertise in reactor design, fuel-cycle management, and regulatory governance. However, the expansion of the sector has been historically constrained by regulatory barriers, capital intensity, liability concerns, and limited private-sector participation.

Recent policy reforms signal a decisive shift. The government's commitment to a 100-gigawatt nuclear capacity target by 2047 represents a structural transformation of India's energy architecture, which requires fundamental changes in financing models, industrial participation, regulatory frameworks, and international collaboration.

Japan's Nuclear Recalibration and Strategic Convergence with India

Japan's engagement with nuclear energy is shaped by a complex interplay of historical experience, technological leadership, and contemporary energy imperatives.

Prior to the Fukushima disaster, nuclear power accounted for nearly one-third of Japan's electricity generation, reflecting a strategic commitment to energy security in a resource-constrained environment. The disaster in 2011 precipitated a profound national reckoning, leading to widespread reactor shutdowns, regulatory overhaul, and a temporary pivot toward fossil-fuel imports.

However, the economic, environmental, and strategic costs of this transition soon became apparent. Rising energy prices, increased carbon emissions, and heightened dependence on imported fuels underscored the structural vulnerabilities of a fossil-centric energy model. Public sentiment started to change, acknowledging the indispensability of nuclear energy to Japan's long-term energy security and climate commitments. This reassessment has culminated in a renewed national strategy to restore the contribution of nuclear power to approximately twenty per cent of electricity generation.

Japan's strengths in nuclear materials, precision

manufacturing, and reactor technology position it as a global leader in the sector. Japanese firms dominate critical segments of the nuclear supply chain, including high-performance steels, reactor components, advanced materials, instrumentation systems, and specialized equipment. These attributes align closely with India's strategic priorities, creating a mutual complementarity that underpins the strategic logic of India-Japan nuclear cooperation.

Regulatory Transformation and Opening of India's Nuclear Sector

At the heart of India's nuclear transformation lies regulatory reform.

India's nuclear programme, historically characterised by centralised control, state dominance, and limited external participation, has been unable to sustain the scale and pace of expansion that is required in today's energy environment. Recent legislative initiatives seek to dismantle structural constraints.

Proposed amendments to liability legislation aim to align India's regulatory framework with international conventions, reducing risk-exposure for private investors and foreign suppliers. Reforms to the Atomic Energy Act are designed to enable private-sector participation across the nuclear value chain.

This regulatory opening has profound implications. It enables the emergence of a competitive domestic nuclear industry, catalyzes technological diffusion, and accelerates project execution.

However, it also introduces new challenges in regulatory oversight, safety assurance, and public accountability. Establishing an independent, robust regulatory authority is central to sustaining public trust and ensuring operational integrity. Japan's regulatory experience, which emphasizes transparency, procedural rigour, and continuous risk assessment, offers valuable institutional models in this regard.

Industrial Participation and the Role of the Private Sector

The entry of private enterprise into India's nuclear sector marks a structural inflection point.

Major industrial conglomerates have expressed strong interest in nuclear investments, particularly in the context of captive power generation for energy-intensive industries such as steel, aluminium, chemicals, and data infrastructure. For these sectors, nuclear energy offers a reliable, low-carbon alternative to fossil fuels, enabling long-term cost stability, regulatory compliance, and adherence to sustainability goals.

Private-sector engagement introduces new efficiencies, managerial expertise, and financial discipline into the nuclear ecosystem. However, it also necessitates new financing architectures, risk-sharing mechanisms, and insurance frameworks. Nuclear projects involve long gestation periods, high upfront costs, and complex regulatory compliance, rendering conventional project finance models inadequate. With their experience in infrastructure finance, long-term project lending, and sovereign-backed risk mitigation, Japan's financial institutions, particularly JBIC and JICA, are uniquely positioned to support this transition.

Small Modular Reactors and the Transformation of Nuclear Deployment

The emergence of small modular reactors (SMRs) is among the most transformative developments in nuclear technology. Unlike conventional large-scale reactors, SMRs offer reduced capital intensity, modular construction, enhanced safety features, and flexible deployment. SMRs hold particular appeal for India, where the industrial landscape is characterised by dispersed clusters of energy-intensive manufacturing, logistics hubs, and digital infrastructure.

Japan's technological leadership in light water reactor systems, advanced materials, and operational safety complements India's experience in pressurized heavy water reactors and experimental fast breeder technology. Collaborative development of SMR platforms offers opportunities for joint innovation, cost reduction, and global market entry. Over time, such collaboration could position India and Japan as co-leaders in next-generation nuclear deployment, extending their influence across emerging markets in Asia, Africa, and the Middle East.

Fuel Cycles, Waste Management, and Long-Term Sustainability

A central challenge in nuclear expansion is to manage nuclear fuel cycles and radioactive waste. For sustainable nuclear growth, closed fuel-cycle strategies, advanced reprocessing technologies, and secure waste disposal frameworks are necessary. India's longstanding commitment to a closed fuel cycle, anchored in its thorium-based energy strategy, provides a distinct advantage in this domain. Japan's technological expertise in

reprocessing and waste immobilisation strengthens the foundation for bilateral collaboration.

Advanced reactor designs, including fast breeder reactors and hybrid fusion-fission systems, offer pathways to minimize waste volumes, enhance fuel utilization, and reduce long-term environmental risks. Joint research initiatives in these areas could accelerate technological breakthroughs, positioning India and Japan at the forefront of sustainable nuclear innovation. Such collaboration also reinforces strategic autonomy by reducing dependence on imported uranium and mitigating geopolitical vulnerabilities associated with fuel supply.

Social Acceptance and Political Economy of Nuclear Expansion

The long-term success of nuclear expansion ultimately hinges on social acceptance. Public apprehensions regarding safety, environmental impact, and land acquisition present a significant barrier. In India, community resistance has historically delayed or obstructed nuclear projects, which underscores the importance of transparent engagement, equitable compensation, and integration with local development.

Japan's experience offers instructive lessons. Over decades, nuclear host communities benefited from targeted investments in infrastructure, healthcare, education, and social services, which fostered a sense of shared ownership and economic inclusion. Adapting such models to Indian conditions requires institutional innovation, fiscal decentralization, and sustained political commitment.

Strategic Implications and Geopolitical Dimensions

By deepening collaboration in nuclear energy, India and Japan can reinforce their broader strategic alignment in the Indo-Pacific region, advancing a shared vision of open, resilient, and rules-based technological ecosystems.

Joint nuclear ventures in third countries offer avenues for strategic outreach, development diplomacy, and global norm-setting. By providing credible alternatives to state-driven nuclear exports from other major powers, India and Japan can shape emerging nuclear markets through transparent governance, safety excellence, and sustainable financing. This can lead to enhanced geopolitical influence while contributing to global energy security and climate mitigation.

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India-Japan nuclear cooperation carries profound geopolitical significance. In an era marked by intensifying technological competition, supply-chain weaponization, and strategic fragmentation, trusted energy partnerships serve as stabilizing anchors.

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Conclusion

Driven by converging economic imperatives, technological opportunity, and strategic alignment, the India-Japan nuclear partnership is poised to reshape the energy futures of both nations.

Success will depend on sustained political commitment, regulatory clarity, industrial integration, and social consensus. If realised, this cooperation has the potential to establish a new model of strategic energy partnership anchored in trust, innovation, and long-term resilience.

Beyond its bilateral significance, the India-Japan nuclear partnership also offers a blueprint for twenty-first-century energy diplomacy, demonstrating ways for advanced and emerging economies to collaboratively navigate the complexities of decarbonisation, industrial transformation, and geopolitical uncertainty.

In doing so, it affirms the role of nuclear energy as a cornerstone of sustainable and secure global development.


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CHAPTER 9

CRITICAL MINERALS, STRATEGIC AUTONOMY, AND THE INDO-JAPANESE PARTNERSHIP

Introduction

The accelerating transformation of the global energy, industrial, and technological landscape has propelled critical minerals from the margins of strategic discourse to its very centre. What was once confined to niche technical debates has become fundamental to discussions on economic resilience, national security, climate action, and geopolitical alignment.

For India and Japan, two major Asian economies with overlapping vulnerabilities and converging ambitions, securing critical mineral supply chains is both a strategic necessity and an unprecedented opportunity for collaboration.

This chapter examines the evolving strategic significance of critical minerals through the lens of India-Japan cooperation, with particular attention to upstream resource security, midstream processing capacity, downstream manufacturing integration, strategic stockpiling, technological innovation, and geopolitical coordination. The analysis frames mineral security not as a discrete sectoral issue but as a systemic challenge requiring integrated policy responses and sustained bilateral collaboration.

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Over the past decade, the strategic importance of minerals such as lithium, cobalt, nickel, copper, rare earth elements, and advanced alloys has intensified rapidly. This escalation has been driven by the global transition toward renewable energy, electric mobility, digital infrastructure, AI, defence modernization, and advanced manufacturing.

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The critical mineral supply chains on which the new technologies are fundamentally dependent are the most acutely concentrated in China, which dominates mining, refining, processing, and manufacturing across nearly all segments of the value chain. For countries seeking to maintain technological autonomy, economic competitiveness, and geopolitical flexibility, this structural dependency amounts to a profound vulnerability.

India's rapidly expanding economy, its ambitious decarbonization targets, and its demographic dividend demand the creation of robust manufacturing ecosystems that are capable of generating employment at scale. Japan, which is facing demographic stagnation, industrial restructuring, and strategic exposure to external supply disruptions, seeks to diversify sourcing while maintaining its leadership position in advanced materials, precision manufacturing, and industrial processing. These complementary imperatives provide a powerful foundation for deepened cooperation.

The Scale of the Challenge

The demand for critical minerals in India is set to multiply dramatically.

The mass deployment of EVs, renewable energy installations, grid-scale battery storage, semiconductor manufacturing, and production of green hydrogen, all require vast quantities of specialized materials. India's ambition to become a global manufacturing hub also demands secure and affordable access to mineral inputs across a range of industrial sectors from steel and aluminium to electronics and defence.

Recognizing this, India has initiated a comprehensive National Critical Minerals Mission that seeks to build resilience across the entire value chain by combining domestic exploration, overseas investments,

expansion of processing capacity, recycling infrastructure, and institutional reform. Key objectives include auctioning new mining blocks, creating overseas mineral acquisition entities, establishing strategic stockpiles, promoting domestic refining and processing, and accelerating recycling capabilities.

At the heart of this effort is recognition that mineral security cannot be achieved through any single pathway. Domestic resources, while important, are unlikely to meet all of India's requirements in the near term. Overseas acquisitions are essential but increasingly competitive. Processing capabilities need advanced technologies, large capital investments, and long gestation periods. Recycling, while promising, depends on end-of-life material flows that will mature only gradually.

All of this underscores the need to have a diversified, layered strategy that integrates domestic capacity-building with international partnerships.

Japan's Experience and the Lessons for India

Japan's experience offers valuable insights into navigating these complexities. As a nation with minimal natural resources, Japan has long relied on a sophisticated strategy of overseas investment, technological innovation, recycling, and strategic stockpiling. Over several decades, it has developed institutional mechanisms to mitigate supply risks, particularly in rare earths, specialty metals, and energy resources.

Significant turning points in Japan's critical minerals policy emerged during earlier episodes of export restrictions that exposed the fragility of highly concentrated supply chains. Japan's response was to adopt a multi-pronged approach focused on overseas resource development, urban mining and recycling, substitution research, domestic exploration, and international cooperation.

This integrated strategy significantly enhanced supply resilience and created institutional frameworks that were capable of responding quickly to external shocks.

India finds itself at a similar juncture today. Its exposure to critical minerals vulnerabilities is yet to reach crisis levels, but the trajectory of its industrial and energy transition suggests that such risks will intensify rapidly. Preemptive action is therefore essential.

Japan's expertise in upstream project evaluation, midstream processing technologies, financing structures, risk mitigation mechanisms, and regulatory governance complements India's scale, workforce, market potential, and policy momentum.

Upstream, Midstream, and Downstream Dimensions

The upstream segment of the critical mineral value chain presents formidable challenges. Mining projects typically involve long development timelines, high capital intensity, complex environmental clearances, and substantial geopolitical risk. Collaborative ventures between Indian and Japanese firms, supported by sovereign financial institutions and diplomatic backing, can significantly enhance project viability and risk diversification.

Japan's experience underscores the importance of patience and strategic foresight: many mining projects take over a decade to become operational, and success requires deep engagement with host governments, community stakeholders, environmental regulators, and global commodity markets.

The midstream segment, encompassing mineral processing, refining, and material upgrading, represents the greatest concentration of market power globally, with China commanding dominant shares across nearly all critical mineral processing chains. India is uniquely positioned to emerge as a major processing hub, particularly among non-Chinese economies, given relatively low energy costs, expanding industrial infrastructure, a skilled workforce, and a supportive policy environment.

But technology remains a crucial bottleneck. Japanese companies have long demonstrated leadership in materials science, metallurgical engineering, and industrial process optimization; their participation in India's processing sector through joint ventures, technology licensing, and equity partnerships could dramatically accelerate capability development.

Downstream manufacturing constitutes the final and most visible segment of the value chain. India's expanding electric mobility market, ambitious renewable energy targets, and rapidly growing digital economy, together create a massive demand for mineral-intensive technologies. Grid-scale energy storage is emerging as a cornerstone of India's energy transition strategy. EVs represent another powerful driver of demand; the transition will significantly increase the demand for lithium, nickel, cobalt, manganese, graphite, copper, and rare earth magnets.

For processing investments to be viable, downstream manufacturing scale must materialize rapidly. However, affordable access to processed materials is essential for manufacturing competitiveness. This underscoring the need for integrated policy frameworks that align mining, processing, manufacturing, and infrastructure development.

Stockpiling, Geopolitics, and Innovation

Strategic stockpiling plays an essential role in enhancing supply resilience. Japan's experience illustrates the importance of carefully calibrated stockpiling mechanisms that operate as strategic insurance rather than commercial instruments, triggered only under severe disruption scenarios and coordinated with international partners to minimize market distortion.

Coordinated planning and information sharing between India and Japan can enhance collective preparedness without the complexity of full joint stockpiling arrangements.

Geopolitics increasingly shapes the contours of critical mineral policy. Export controls, tariffs, industrial subsidies, and security screening mechanisms have proliferated as nations seek to protect domestic industries and reduce external dependencies. To navigate this evolving policy landscape, India and Japan need agility and coordination.

Bilateral agreements on technology cooperation, financing mechanisms, regulatory harmonization, and industrial standards can significantly lower transaction costs and accelerate project execution. Multilateral platforms, including partnerships with like-minded economies, will amplify strategic leverage and diversify sourcing opportunities.

Innovation remains another critical pillar. Substitution research aimed at reducing mineral intensity, alternative chemistries for batteries, advanced recycling technologies, and next-generation materials can mitigate supply risks over time. Collaborative research initiatives between Indian and Japanese institutions, supported by public funding and industrial participation, can accelerate breakthroughs that reshape future value chains.

Social acceptance and environmental stewardship are important too. Transparent governance frameworks, fair compensation mechanisms, community development initiatives, and stringent environmental standards are key to maintaining public trust and project legitimacy.

Conclusion

The strategic imperative for Indo-Japanese cooperation in critical minerals transcends transactional economics. It reflects a shared vision of sustainable development, technological leadership, and geopolitical stability.

By aligning industrial policy, diplomatic engagement, technological collaboration, and financial mechanisms, the two partners can build resilient supply chains that support their long-term development objectives while contributing to global economic security.

The path ahead will not be linear. Volatile commodity markets, evolving geopolitical alignments, technological uncertainty, and environmental constraints will introduce persistent complexity.

But through sustained political commitment, institutional coordination, and private-sector engagement, India and Japan can shape a new model of mineral security partnership that will safeguard their own economic futures while contributing to a more stable, diversified, and resilient global critical minerals ecosystem.


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CHAPTER 10

DEFENCE INNOVATION AND STRATEGIC PARTNERSHIP: REIMAGINING INDIA-JAPAN COOPERATION

Introduction

The strategic landscape of the Indo-Pacific has placed unprecedented emphasis on defence innovation, technological self-reliance, and resilient industrial partnerships.

Against this backdrop, India-Japan cooperation in defence technology has acquired renewed salience, driven by converging geopolitical imperatives, overlapping security challenges, and complementary industrial capabilities. As the bilateral relationship matures into a Special Strategic and Global Partnership, defence innovation is increasingly emerging as both a critical test and a defining opportunity for the next phase of engagement.

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Over the past two decades, India and Japan have steadily deepened cooperation across diplomatic, economic, security, and technological domains. This expansion reflects not just shared interests but also a convergence of strategic outlooks shaped by the rise of China, uncertainty surrounding the future of US regional primacy, intensifying technological competition, and growing pressure on global supply chains. Defence cooperation represents a natural extension of this broader alignment.

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Yet while operational engagement through joint exercises, logistical arrangements, and multilateral coordination – particularly under the Quad framework – has progressed substantially, collaboration in defence technology and industrial innovation has lagged behind its potential.

This chapter examines the evolving contours of India-Japan defence innovation cooperation, identifying structural constraints, emerging opportunities, and strategic pathways forward.

It situates defence technology partnership within the broader transformations reshaping global security, industrial policy, and warfare itself, and argues that India and Japan are now at a strategic inflection point where they can either adapt rapidly to the accelerating pace of technological change and industrial competition or risk strategic marginalisation in an era that is increasingly defined by speed, scale, and innovation.

Strategic Context: The Transformation of Security and Warfare

The character of warfare is undergoing profound transformation, driven by advances in AI, robotics, cyber capabilities, space-based assets, autonomous systems, quantum technologies, and high-energy weapons. Traditional paradigms of platform-centric military power are giving way to networked, software-driven, data-intensive operational models. This shift has dramatically compressed innovation cycles, altered procurement logic, and blurred distinctions between civilian and military technologies.

For both India and Japan, these transformations coincide with intensifying external pressures.

China's rapid military modernisation, expanding maritime footprint, and aggressive grey-zone operations across the Indo-Pacific have fundamentally altered regional threat perceptions. North Korea's advancing missile and nuclear programs, coupled with Russia's demonstrated willingness to use force to revise borders, have

underscored the fragility of existing frameworks of deterrence.

Japan's response has been particularly consequential. The adoption of a new National Security Strategy and National Defence Strategy in 2022 marked the most significant shift in Japan's defence posture since the end of the Second World War, formalising a decisive departure from purely defensive doctrines and emphasizing counter-strike capabilities, integrated air and missile defence, enhanced maritime domain awareness, and expanded defence spending.

India, for its part, faces a complex multi-front security environment that includes contested land borders, persistent maritime challenges, and expanding cyber and information warfare threats. India's defence policy framework, anchored in the concept of Atmanirbharta (self-reliance), seeks to transform the country from a predominantly import-dependent military power into a globally competitive defence manufacturing and innovation hub.

Japan's Defence Industrial Transformation

Japan's defence industry has historically been characterized by high technological sophistication, precision manufacturing, and world-class engineering capabilities. However, it has also been constrained by a legacy of restrictive export policies, fragmented industrial organization, and limited exposure to international markets. These factors have contributed to high unit costs, small production runs, and a predominantly domestic orientation.

The recent easing of Japan's defence export regulations is, therefore, a very important development that signals not only a policy shift but a broader reimagining of Japan's role as a proactive contributor to regional security. The gradual dismantling of legal and institutional barriers is enabling Japanese firms to engage more confidently with international partners, participate in co-development programs, and integrate into global defence supply chains.

But significant challenges remain. Japan's defence industrial base is dominated by large conglomerates with deeply embedded production systems that are optimized for domestic requirements. Integrating dual-use technologies, fostering innovation-driven startups, and cultivating flexible supply chains capable of responding to rapidly changing operational demands require structural reform. Labour constraints, demographic decline, and limited manufacturing scalability pose additional obstacles.

In this context, collaboration with India offers strategic advantages: India's expanding manufacturing ecosystem, abundant engineering talent, and rapidly growing defence market provide opportunities for scale, cost optimization, and innovation diffusion.

India's Defence Industrial Ambitions

India's defence industrial transformation is unfolding against the backdrop of ambitious policy reforms aimed at reducing import dependence, stimulating private-sector participation, and fostering indigenous innovation. The government's emphasis on domestic manufacturing, supported by targeted procurement reforms, PLIs, and expanded R&D funding has catalyzed unprecedented private-sector engagement.

Indian startups, SMEs, and emerging defence manufacturers are increasingly active in domains such as unmanned systems, cybersecurity, electronics, advanced materials, and software-defined platforms. However, challenges persist, including gaps in high-end manufacturing, quality control, systems engineering, and long-term financing.

The complexity of modern defence technologies demands integration across multiple domains from semiconductors and photonics to propulsion systems and quantum sensing – areas in which India continues to depend on external partners. Japan's technological strengths in advanced propulsion, marine gas turbines, aircraft engines, stealth materials, precision manufacturing, robotics, and sensor technologies align closely with these requirements.

Structural Impediments to Collaboration

Despite strong strategic logic, India-Japan defence cooperation has historically been constrained by structural impediments.

From the Indian perspective, defence procurement has traditionally emphasized cost competitiveness, scale, and rapid induction – an approach that often prioritizes lower-cost suppliers, creating challenges for high-end technologies that inherently entail higher development costs. Bureaucratic inertia, complex approval processes, and risk-averse administrative practices can significantly delay the adoption of innovation.

Japanese firms on the other hand operate within industrial cultures that emphasize meticulous

planning, rigorous documentation, quality assurance, and incremental innovation. While these practices ensure exceptional reliability and performance, they can appear slow and inflexible in fast-moving operational environments. Furthermore, Japanese companies have been historically reluctant to engage in complex international procurement processes that involve regulatory uncertainty and fluctuating requirements.

These differences are compounded by divergent approaches to technology transfer, intellectual property protection, and joint development. Overcoming these structural mismatches requires not only technical solutions but also cultural adaptation, institutional trust-building, and sustained political commitment.

Emerging Domains of Strategic Convergence

While traditional defence platforms remain important, the biggest promise for India-Japan collaboration lies in emerging and disruptive technologies. Quantum technologies represent a particularly significant frontier – applications in secure communications, navigation in GPS-denied environments, sensing, and cryptography hold transformative potential for military operations. India and Japan, both possessing advanced scientific ecosystems, are well-positioned to pursue joint research and development in this domain.

Robotics and autonomous systems constitute another critical area. The increasing deployment of unmanned aerial, surface, and underwater platforms is reshaping operational doctrines, logistics, and force projection. Japanese expertise in robotics and precision engineering complements India's strengths in software, AI development, and large-scale manufacturing.

Space-based capabilities, including satellite communications, navigation, remote sensing, and space situational awareness are becoming central to modern warfare. India's demonstrated proficiency in cost-effective space launches and Japan's strengths in sensor technologies and satellite manufacturing provide a natural basis for collaboration.

Maritime domain awareness and undersea warfare technologies constitute another pillar of potential cooperation. The growing complexity of maritime security challenges calls for advanced surveillance, sensor fusion, and autonomous monitoring systems. Joint development of underwater drones, acoustic sensing technologies, and AI-driven analytics could significantly enhance regional maritime security.

High-energy weapons, particularly directed-energy systems for air and missile defence, offer transformative cost advantages, with Japanese capabilities in materials science, optics, and precision manufacturing complementing Indian advances in power systems and electronics.

Maritime Security as a Strategic Anchor

The maritime domain is one of the most mature and strategically significant areas of India-Japan defence cooperation.

The two countries share deep stakes in the security of sea lines of communication, freedom of navigation, and stability across the Indo-Pacific. Their collaboration encompasses bilateral naval exercises, coast guard engagements, logistics agreements, and participation in multilateral frameworks such as the Quad.

Maritime security also offers fertile ground for technological innovation. Advances in maritime domain awareness, including satellite surveillance, underwater sensor networks, and AI-enabled analytics are redefining naval operations.

The maritime domain is increasingly characterized by hybrid threats, including grey-zone operations, maritime militia deployments, and environmental exploitation. Joint development of sophisticated monitoring and detection technologies could strengthen regional governance while reinforcing deterrence.

Governance, Regulation, and Strategic Disruption

Tensions between regulation and agility is a recurrent theme in discussions on defence innovation. Traditional procurement systems, which are designed to ensure accountability and financial prudence, often struggle to accommodate the rapid pace of technological change. Lengthy approval cycles, rigid compliance frameworks, and risk-averse institutional cultures can stifle innovation and deter private-sector participation.

Several advanced militaries are undertaking radical reforms to dismantle bureaucratic barriers and accelerate capability development, experimenting with outcome-based procurement models, rapid prototyping pathways, and private-sector-led innovation frameworks.

For India and Japan, embracing such disruption offers both opportunities and challenges. Regulatory reform must balance innovation with

accountability, ensuring that agility does not compromise transparency or strategic coherence. New models of collaboration, such as joint R&D enterprises, co-funded innovation hubs, and cross-border startup ecosystems, offer promising pathways going forward. By fostering integrated innovation networks spanning academia, industry, and defence establishments, India and Japan can accelerate technological development while mitigating systemic risk.

Public Perception and Strategic Culture

Public opinion plays a critical role in shaping defence policy, particularly in democratic societies.

The legacy of post-war pacifism constrained defence activism and international military engagement in Japan, but there has been a marked change in public attitudes in recent years, driven by rising regional insecurity and evolving threat perceptions. Opinion surveys increasingly indicate majority support for expanded defence spending, constitutional revision, and enhanced international security cooperation. This has opened up political space for deeper defence partnerships, including technology collaboration and industrial integration.

In India, public opinion strongly favours strategic autonomy and national security, and defence innovation aligns closely with broader aspirations of technological leadership and global stature.

Aligning public narratives, managing expectations, and communicating the strategic rationale for defence cooperation are essential for sustaining political support. India-Japan collaboration must be framed as more than a transactional arrangement – rather, as a long-term partnership that contributes to regional stability, economic resilience, and global public goods.

Toward a New Model of Defence Partnership

India and Japan possess the strategic alignment, technological complementarity, and political momentum necessary to forge a new model of defence cooperation, which transcends traditional buyer-seller dynamics to emphasize co-development, shared innovation, and integrated industrial ecosystems.

Key elements of the cooperation would include early-stage joint design processes, collaborative R&D funding mechanisms, startup-to-startup partnerships, and long-term production planning. Emphasis would shift from platform-centric procurement to capability-driven development, prioritizing adaptability, interoperability, and rapid deployment.

The cultivation of institutional trust is equally important. Transparent governance structures, harmonized standards, and sustained people-to-people engagement across military, industrial, and academic communities can gradually overcome cultural and procedural barriers. Joint training programs, industrial exchanges, and collaborative research platforms can foster mutual understanding and operational synergy.

Conclusion

India-Japan defence innovation cooperation is at an inflection point. The accelerating pace of technological change, intensifying geopolitical competition, and growing complexity of security challenges demand bold and imaginative responses. Incremental adjustments to existing frameworks will not suffice.

By embracing strategic disruption, institutional reform, and technological collaboration, India and Japan can not only enhance their own defence capabilities but also shape the future architecture of security in the Indo-Pacific. Their partnership holds the potential to redefine defence industrial cooperation, offering a model grounded in trust, innovation, and shared strategic purpose.

At a time of uncertainty and transformation, the strength of alliances will increasingly depend not on the size of arsenals but on the agility of institutions, the depth of technological integration, and the resilience of industrial ecosystems. The India-Japan partnership, if fully realized, can emerge as a cornerstone of this new strategic paradigm.

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