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## Japan's Techplomacy In India

*Mapping Next-Gen Collaborations*

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**Abstract:** The current landscape of bilateral relations in South Asia is primarily led by the technological cooperation among the major and developing economies. Japan; a tech precursor, guiding the biggest economy of South Asia i.e. India, with all its might. This mutual strategic cum futuristic Techplomacy of Japan is changing the face of manufacturing, R&D, supply chain, and policy framework in India leading to fostering next-gen tech collaborations. The revamped ODA policies implemented by Japan in sectoral assistance through major cooperation agencies are changing the nature of collaboration among the corporations in both countries.

This paper is going to assess the key technological sectors where Japan is focused on cooperating with India in the co-development of next-gen collaborations. The techplomatic approach, policies, and joint initiatives will be thoroughly analysed in the paper to trace the major milestones achieved in the post-COVID phase. Due to the fast-changing nature of next-gen techs, the development of partnerships in the technology domain poses complex challenges to the countries. This paper is taking the wholesome analytical approach to examine the lacunas in Japanese approach to the Indian tech ecosystem too.

**Index Terms** - Artificial Intelligence, Digitalization, STI Diplomacy, Technology, Technology Diplomacy, Tech Innovation, Techplomacy

### I. BACKGROUND

The bilateral relations between India and Japan began in 1952 under the peace treaty signed by both the nations (Ministry of Foreign Affairs of Japan, 2024). However, technology is a comparatively new paradigm of cooperation between India and Japan as these formally evolved in 1985 (Punnen, 2020). Technology is developed to make the lives of people easier and India is an emerging power in the IT sector spearheading innovation. India's exports majorly comprise of IT and BPO amounting to 60 per cent of total exports registering a CAGR of 14 per cent (EY India, 2023). Technology is the leading force of the contemporary world with a role to play in every sector including education, healthcare, agriculture, manufacturing and others. Investment in the technology sector provides great returns in the long run as depicted in India's case where the IT and BPO contributed around seven per cent to the GDP in FY2023-2024 (MeitY, 2024).

Thus, India needs the imperatives of technology and capital assistance from Japan to excel further in the digital world (Panda, 2020). Japan and India are working on several areas of technology cooperation such as space explorations, development and use of clean energy thereby monitoring the air quality, automobile industry and various high-speed rail projects including the prestigious MAHSR (Mumbai-Ahmedabad High

Speed Rail) (JICA, JICA Extends Technical Cooperation for Station Area Development along Mumbai - Ahmedabad High Speed Rail (MAHSR) Corridor, 2022) and LUPEX Mission (Singh, 2024) among others.

## II. RELEVANCE OF THE RESEARCH

Japan's Techplomacy in South Asia is evident in the 21st century resulting in establishment of multiple mega projects in India. The future of India-Japan relations majorly relies on the deepening tech cooperation augmenting economic growth & mapping new frontiers of innovative agreements ahead. Japan; as a country was one of the first 'Asian Tiger' reached peak levels of high-growth economies in the past. It was fuelled by gigantic exports backed by rapid industrialization sourced from the technological assistance of USA and other favourable nations in in 1960s, 1970s and 1980s.

Japan adapted the new techs in the same decades transforming itself from agro based feudal society to one of the leading industrial nations of the world. The selective acquisition & mastering the moulding as per requirements, turned Japanese technical cooperation with Western giants possible. The same developmental approach was observed in Indian context when Japan started supporting technological spree of India through transit sector initially and slowly entered manufacturing, clean energy, disaster management and defense through joint venture model.

To study the Japanese technological growth story is a worthwhile analysis for Indian technological endeavours and aspirations to achieve necessary tech advances for its own societal cum economic cum industrial cum societal growth. That's why the study of Japan's technology journey and its use in national policy to determine foreign policy factors makes this research more critical in the current times. It gives us clear details of how the state of Japan used techplomacy as a tool in their foreign policy instruments.

### 2.1 Research Plan

As we all know that Japan has a very crucial private dynamism which played a vital role in mastering frontline techs not only in the domestic market but in the international exports too. It led them to made them – an only country, ready to run exponential growth for largest period of time in human history for approximately three decades. The governmental assistance and private fundings make this run speedier till 21st century.

This background makes it more acceptable for Indian growth ecosystem to augment own industrial frameworks in accordance to Japanese growth models. This research will analyse the major sectors and the development of India-Japan collaborations in technological arena to conclude future trajectory and its relevance in current global order.

### 2.2 Research Gap

Post 2000, nation navigated through economic shifts, demographic challenges and ever-accelerating pace of technological advancement which turned the country towards vicious circle of domestic stagnation. The cycle started in first decade of this century and still crunching Japanese aspirations to push domestic consumption ahead. It impacted technology percolation to every household unlike other developing countries and technology dispersion. The firm technological industrial foundation, embarked Japan on multifaced approach to innovation addressing both domestic needs and global opportunities.

As of now, there is no cumulative study on the overall technology domain which is affecting bilateral relations of these countries in overall. This gap will be addressed by this research which will open the doors for further

researchers to work upon individual sectors covered in this study. The research is a consolidated study of tech collaborations between India-Japan which is left over in academia bypassing focus on industrial studies only.

### III. INTRODUCTION

The term 'Technology' is the word of the contemporary era and ever since globalization<sup>1</sup> policy was adopted by the Prime Minister Mr. P. V. Narasimha Rao government in India in the 1990-91, its stance was further strengthened with the National Telecommunications Policy in 1994 (Panagariya, 2004, p. 27). Japan and India collaborate in several areas including trade, defense, manufacturing and others but the cooperation associated with science, innovations and technology is of a relatively recent origin, it had officially begun only in 1985 with the Inter-Governmental Agreement.

As of the year 2024, India is one of the largest exporters of IT sector and India's service sector is expanding at a faster pace and in FY2022-2023 it saw a rise of 10 per cent (CII, 2024). Both India and Japan understand the vast potential of technology thus have adopted bilateral cooperation initiatives to adapt to the dynamics of newer digital technologies. An innovation in the field of technology is aimed at enhancing the speed, efficiency and outcomes of a certain task, for instance the Shinkansen<sup>2</sup> technology developed by the Japanese and later adopted by India is targeted towards making the travel faster and comfortable. The technology partnership between Japan and India is built on the commitment to leveraging technology in attaining sustainable development while facilitating knowledge transfer in that it enhances regional connectivity. Techplomacy<sup>3</sup> acts as an active instrument for both countries to materialize mutual gains simultaneously.

In joint research projects, capacity-building programs, as well as investments in industries driven by technology, engagement in India by Japan typifies a model of diplomacy, bringing innovation and development to each other's shores. It then highlights what potential a technology diplomacy can be at the moment in strengthening the bilateral relationship, promoting the pace of economic growth, or facing these pivotal global and regional challenges such as climatic change, urbanization and digital inclusion. Ultimately, it underlines potential transformative changes that Japan and India have driven at home but also across their great Indo-Pacific region and worldwide.

### IV. HYPOTHESIS

Japan's technology diplomacy instrumentalized mutual benefits for India & Japan while developing its own role in foreign policy instruments.

#### 1. Literature Review

##### A. *Scaling India-Japan Cooperation in Indo-Pacific and Beyond 2025: Corridors, Connectivity and Contours* (Edited by Jagannath P. Panda, 2020)

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<sup>1</sup> International Monetary Fund defines globalization as the increased flow of ideas, people, goods, services and capital that leads to integration of different societies and economies across the world (International Monetary Fund, 2022).

<sup>2</sup> The Tokaido Shinkansen High-speed rail (HSR), that was introduced in Japan in 1964. "The Shinkansen brought a paradigm shift in the flow of business and tourist passengers to the 500 km-long metropolises, resulting in remarkable economic development and changes in the social environment" (Shuji Sugimori, 2022).

<sup>3</sup> The term 'Techplomacy' was introduced by the Danish government to refer to the relations between the national governments and private sector companies (Norkunas, 2022).

The book 'Scaling India-Japan Cooperation in Indo-Pacific and Beyond 2025: Corridors, Connectivity and Contours', edited by Jagannath P. Panda, 2020, is based on an elaborate exploration of the evolving geopolitical and strategic dynamics between India and Japan alongside focusing on regional cooperation in the Indo-Pacific region. The book ventures into diverse strategic horizons such as technology cooperation, economic corridors, connectivity initiatives and the role of China in shaping India-Japan relations. This book provides critical insights into the broader strategic context in which India-Japan collaboration in the field of technology are evolving and brings into light the imperatives of such a bilateral cooperation in driving holistic and inclusive development, particularly in the decade leading up to 2020 and beyond.

### **B. India-Japan Technology Ties (Written by Joseph Punnen)**

Joseph Punnen's paper titled 'India-Japan Technology Ties' has done deep analysis on the development of technological cooperation between India and Japan and where it stands today. As the paper states, collaboration between India and Japan transcends into defense sectors by way of co-development and co-production activities set forth in Japan-India Vision 2025. The cooperation between India and Japan in the defense sector is targeted towards enhancing the individual security mechanisms through mutual technology developments. Punnen quotes certain joint statements issued by organizations like Japan's IPA (Information-Technology Promotion Agency), JETRO (Japan External Trade Organization) and the iSPIRT (Indian Software Product Industry Roundtable) that iterate the commitment on account of both the countries to share information about digital infrastructure development.

According to Punnen, this collaboration aims to improve architecture design and promote a new digital society that exploits real-time data for the betterment of society and industries. The document also talks about a collaborative model in Asia, where Japan contributes technology and capital and India offers global human resources. It is expected to address the region's infrastructure deficits and shortages of skills for rapid growth and development. Punnen's work shows the dynamic and multifaceted nature of India-Japan technological cooperation, which developed from formal agreements to strategic partnerships that incorporate digital infrastructure, defense and global development initiatives.

## **2. Research Methodology**

*Qualitative analysis of statistical data from official sources of both the nations* including the examination of official treaties, memoranda of understanding (MoUs), joint statements and press releases from both the Indian and Japanese governments and Embassies. This is supplemented by the method of *geopolitical and strategic framework analysis* that involves the examination of the role of regional geopolitical dynamics, particularly in the context of the South Asian outreach focusing India.

The multinational corporations of both countries and their role to understand the technology cooperation between India and Japan aligns with their respective national interests and the attain the broader goal of human welfare. Relevant data has also been sought from websites pertaining to certain private sector entities. The data thus sought has been used to understand the importance of private sector players in the field of IT industry.

## V. PICTORIAL REPRESENTATION OF TECH TIES

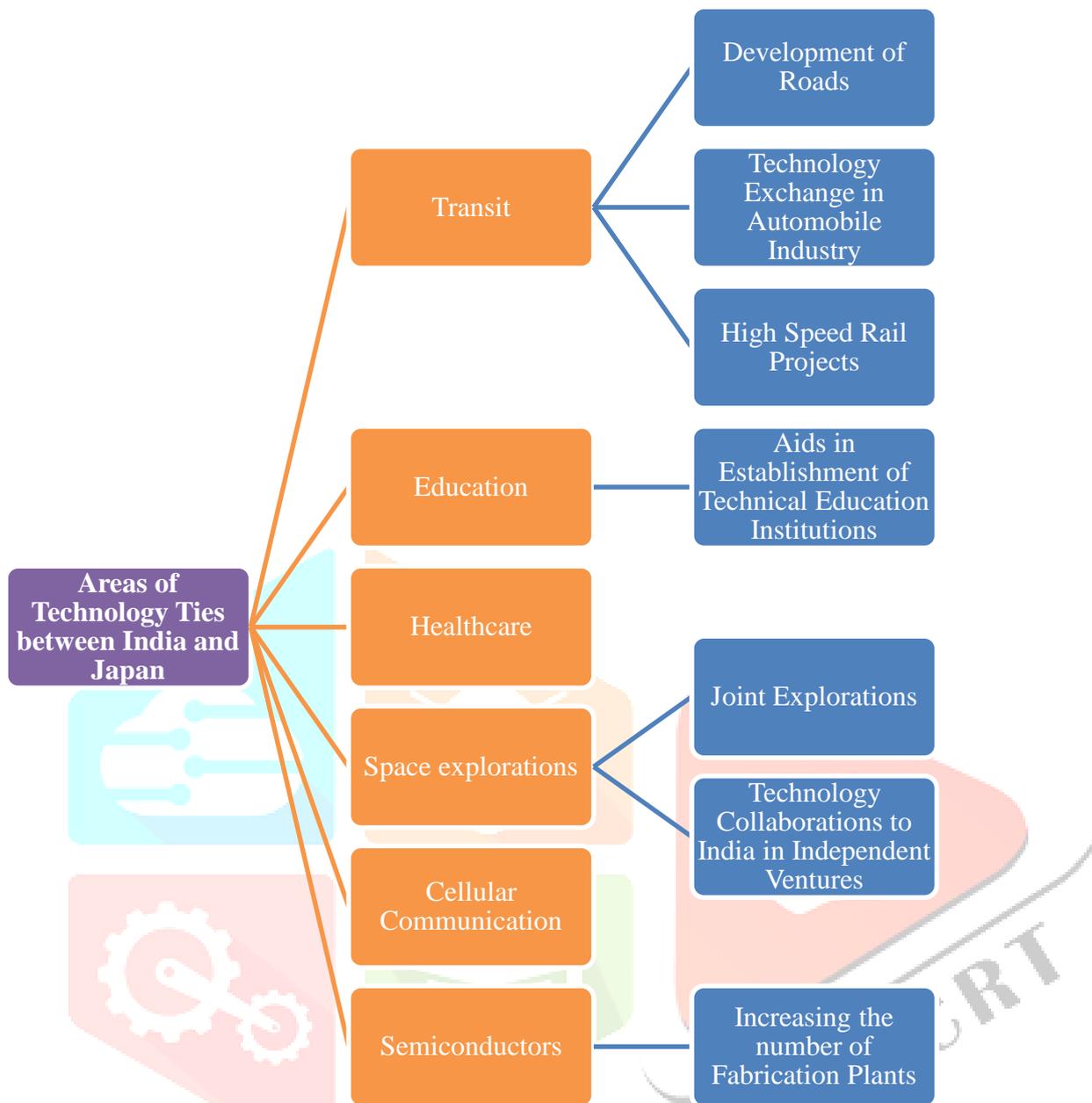


Figure-1: Areas of technology ties between India and Japan

According to Figure-1, India and Japan cooperate on different aspects of technology use viz., education, healthcare, transit, space explorations, semiconductors, cellular communication and others mostly.

## VI. JAPAN AS A TECHNOLOGY PRECURSOR

After the MEA (Ministry of External Affairs), Government of India and the MEXT (Ministry of Education, Culture, Sports, Science and Technology), Government of Japan, signed the Inter-Governmental Agreement in the year 1985, the India-Japan S&T cooperation was formalized. In 1993, the India-Japan Cooperative Science Program was started between the DST (Department of Science and Technology), Government of India and the JSPS (Japan Society for the Promotion of Science).

It was guided by the IJSC (India- Japan Science Council) in the fields of physical and chemical systems; fundamental science, engineered materials systems; engineering and processes, natural systems; biology and life sciences, global systems; earth-space, marine; and environment and mathematics and computational science. In the year 020, the IJSC dealt with issues related to the Covid-19 pandemic. The joint S&T activities by Japan and India are led by the India-Japan Joint S&T Committee co-chaired by DST and Japanese MoFA

(Ministry of Foreign Affairs). The DST and MEXT signed two IA (Implementation Agreement) one in 2014 and the other in 2022 (Embassy of India, Tokyo, Japan, 2024). Some core research & development capability generation among the countries done in below mentioned sectors –

**a) Education**

The DST and the JST (Japan Science and Technology Agency) signed an MoU in 2006 and also initiated a Strategic International Cooperative Program in 2015 to instrumentalize the joint actions on use of Physical Sciences in ICT (Information and Communication Technology) through AI, Internet of Things and Big Data Analysis to ensure security in the cyber space. Since the year 2008, HOPE meetings are being conducted by the JSPS to facilitate the talented doctoral students' interactions with the Nobel laureates and other eminent scholars. SAKURA Science Program was organized in the year 2015, on the same lines as the HOPE meeting, the former invited exceptional high school students of Asia to universities in Japan to visit the science laboratories and interact with the Nobel laureates. In the year 2017, an LoI (Letter of Intent) was signed between DST and the JSPS to develop a reciprocal Fellowship Program targeted towards the young researchers (Embassy of India, Tokyo, Japan, 2024). Since the year 2017, India has been participating in the STS, a forum or a global think tank to deliberate on utilization of S&T for human wellbeing. JICA also granted ODA loans to the IIT-H (Indian Institute of Technology, Hyderabad) in 2014 and the IGNOU (Indira Gandhi National Open University) for infrastructure development and scholarships (JICA, Operations and Activities in India, FY 2022 - 2023).

**b) Healthcare**

India spends approximately 2.2 per cent of its budget on the healthcare sector and owing to the surging population and their need India also relies on foreign aid to provide better services to the people. Since 1995-1996, Japan has extended ODA loans worth 284.6 billion yen to India. The AIIMS, India and Osaka University, Japan signed a MoC (Memorandum of Cooperation) and an MoU in the year 2014. The Indian and Japanese governments have signed several MoCs to collaborate the policies of AHMIN scheme by Japan and the AYUSHMAN Bharat by India and also promote the use of the science of Ayurveda in Japan (Embassy of India, Tokyo, Japan, 2024). During the Covid-19 pandemic, Japan extended a monetary grant of one billion yen and an ODA loan of up to 50 billion yen to India as an emergency response support during crisis. During FY2021-2022, JICA financed an ODA loan to the Government of India to improve access and quality of healthcare facilities in the targeted areas in the India state of Assam. Japan also extended ODA loans to other Indian states including Tamil Nadu, Odisha and few Northeastern states (JICA, Operations and Activities in India, FY 2022 - 2023).

**c) Agriculture**

As of the FY2023-2024, Agriculture in India contributes 18.2 per cent to the GDP calculated at current prices and it employs 42.3 per cent of the total workforce in India (PIB, 2024). Thus, infusion of advanced technology into this sector is expected to increase the yield and the income of the farmer, JICA's contributions in this regard prove beneficial for an agricultural sector that is resilient to climate changes and is based on sustainability. Since the year 1988, JICA had financed ODA loans worth 225 billion yen to India, additionally JICA is also supporting agricultural project in different Indian states such as Mizoram, Himachal Pradesh, Odisha, Uttarakhand, Andhra Pradesh, Rajasthan and Jharkhand. In Jharkhand, as of the year 2022, the JICA

launched 13,274 MDI (Micro-Dip Irrigation) projects to intensify horticulture and thereby empower the women (JICA, Operations and Activities in India, FY 2022 - 2023).

In 2015, an MoC targeting seven areas of cooperation viz., human resource development and institutional exchange between training institutes; sustainable forest management; enhancement of forest conservation and forest disaster prevention; conservation of biodiversity; effective utilization of forest resources; enhancement of relevant policies on forests; and forestry and technologies and Research and development in forestry sector was signed by the MAFF (Ministry of Agriculture, Forestry and Fisheries), India and the MoEF&CC (Ministry of Environment, Forestry and Climate Change), India (Embassy of India, Tokyo, Japan, 2024).

#### **d) Atomic and Nuclear Energy**

These are among the renewable sources of energy and therefore need detailed study to be utilized more optimally. In 2013, an MoU was signed between INS (Indian Nuclear Society) and JAES (Japan Atomic Energy Society) to promote peaceful use of the nuclear energy. In 2020, the meeting on Japan-India civil nuclear cooperation was held in Tokyo, Japan where the representatives of the Government of Japan and the Indian representatives of Department of to pursue the Japan-India joint statement that was signed at the Japan-India Summit 2017 meeting with the agenda of strengthening the bilateral cooperation in the peaceful use of nuclear energy. In 2021, a virtual meeting on civil nuclear cooperation between DAE and METI the points on the meeting agenda were hydrogen thermo power, India's nuclear energy policy, SMRs (small and modular reactors), CLND Act, Rare Earths Minerals and GCNEP (Embassy of India, Tokyo, Japan, 2024).

#### **e) Space Sector Collaborations**

The formal cooperation between ISRO (Indian Space Research Organization) and JAXA (Japan Space Exploration Agency) began in the 1960s with the establishment of Thumba Equatorial Rocket Station at Thiruvananthapuram, Kerala, India. In the year 2005, the 'Arrangement concerning the considerations of potential future cooperation in field of outer space' was signed ISRO and JAXA. Later the ISRO and JAXA, signed cooperative documents addressing lunar exploration, satellite navigation, X-ray astronomy and APRSAF (Asia Pacific Regional Space Agency Forum). In 2016, ISRO and JAXA agreed on an MoU to enhance cooperative activities and promote peaceful use of outer space (Embassy of India, Tokyo, Japan, 2024). The first meeting of Indian and Japanese authorities was held on March 08, 2019, this dialogue brought the space related agencies and ministries of both nations together to deliberate on the issues of Space Situational Awareness, global, satellite navigation systems policies on space security, space industry bilateral cooperation of ISRO and JAXA. This space dialogue is also credited for devising an opportunity to meet on a regular for discussing the space policies of mutual interest of both the countries (MOFA, 2019).

The second dialogue in the series of India-Japan Space Dialogue was held on a virtual platform on November 2, 2021. This dialogue provided an opportunity to both the nations to exchange information on the space policy of each country and offered an avenue to discuss space security, bilateral cooperation among JAXA and ISRO, space industries, global navigation satellite systems, SSA (Space Situational Awareness), space-related rules and norms and other areas of mutual interest of India and Japan (Embassy of India, Tokyo, Japan, 2024). The LUPEX<sup>4</sup> project also known as the Lunar Polar Exploration (Natsu, 2024) is a collaborative effort

<sup>4</sup> Mission is scheduled for launch in 2025.

by Japan and India, designed to advance the understanding of the Moon by searching for water and other resources available there while building expertise in lunar surface exploration.

**f) Transit Cooperation**

The MAHSR project is being developed with technical and financial support from Japan, based on the Shinkansen technology (Shuji Sugimori, 2022), that is known for its speed, safety, and efficiency. The MAHSR project spans approximately 508 kilometers, connecting Mumbai, the capital city of Maharashtra, and Ahmedabad a city in Gujarat, with a proposed top speed of 320 km/h. It navigates through 12 stations namely, Mumbai, Thane, Virar, Boiar, Vapi, Bilimora, Surat, Bharuch, Vadodara, Anand, Ahmedabad, and Sabarmati.

**g) Cellular Technology and Semiconductor**

During the year 2020, a cyber security pact was signed between India and Japan that allowed a Japanese IT communications company called the NEC Corporation, to invest in India especially in the field of technology, therefore, the NEC set up various R&D centers in Bangalore, Chennai, Noida, and others. The NEC Chennai center had developed the 5G O-RAN (open radio access network) which is an open, cost efficient and flexible network organized as a multi-vendor architecture for deploying mobile networks, in contradiction to the traditional 'single-vendor proprietary architecture' (Punnen, 2020).

In the domain of the semiconductor development both India and Japan resort to self-reliant and innovation-based techniques of production through 'Make in India' and 'Society 5.0' respectively. Japan- India collaboration in the semiconductor industry is driven towards manufacturing specialized chips and increasing the number of semiconductor fabrication plants (fabs) by synchronizing their individual technical knowledge, research and innovations (Pant, 2023).

## VII. FINANCIAL INFUSION

The India-Japan joint S&T is value-laden and is based on 'reciprocity and co-funding' that drive mutual development in the terms of Innovations, SDGs (Sustainable Development Goals) with India as a pilot country and Japan as its partner country under the TFM (Technology Facilitation Mechanism) UN program (Embassy of India, Tokyo, Japan, 2024).

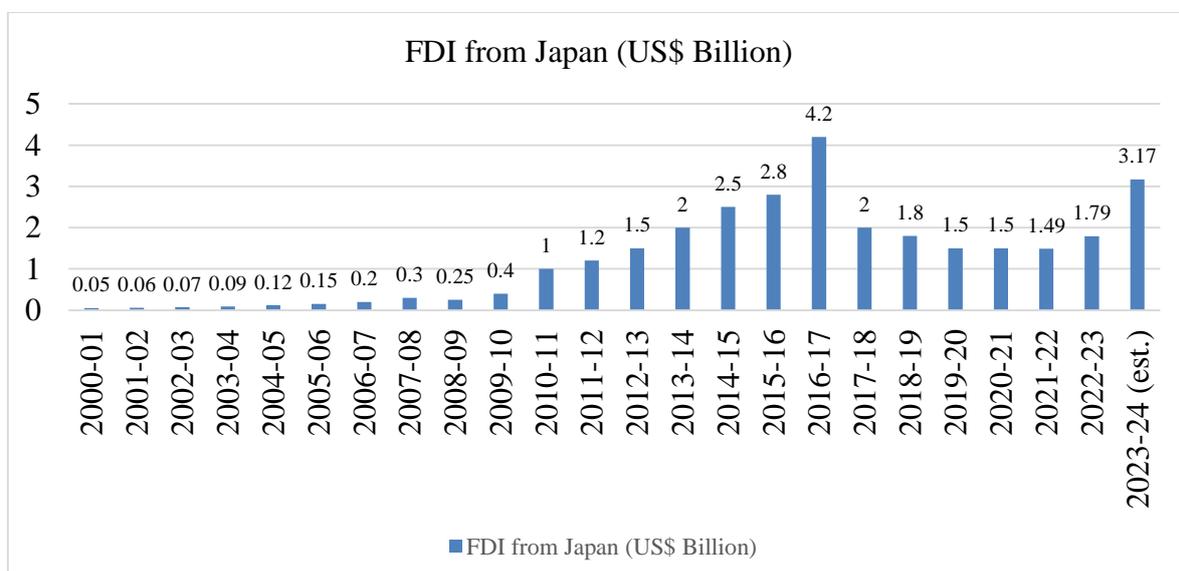


Figure-2: FDI (Foreign Direct Investment) from Japan to India (2000-2024), Source: (CEIC, 2024) (Statista, 2024).

According to figure-2, the FDI from Japan to India has been rising steadily since the year 2000. In the year 2016, the Japanese FDI was at record high of 4.2 billion USD. The FDI registered a declining trend between 2017-2022. In the year 2022, it followed an upward movement to reach 3.17 billion USD as estimated for 2023-2024.

### ODA to India

JICA began extending the financial assistance to India since 2003 in the form of Official Development Assistance (ODA). According to the above figure-3, JICA assistance to India has been following an upward trend since 2010, it declined slightly in 2014-2015, however, it adopted a rising from the year 2015 indicating heavier dependence of India on foreign aid.

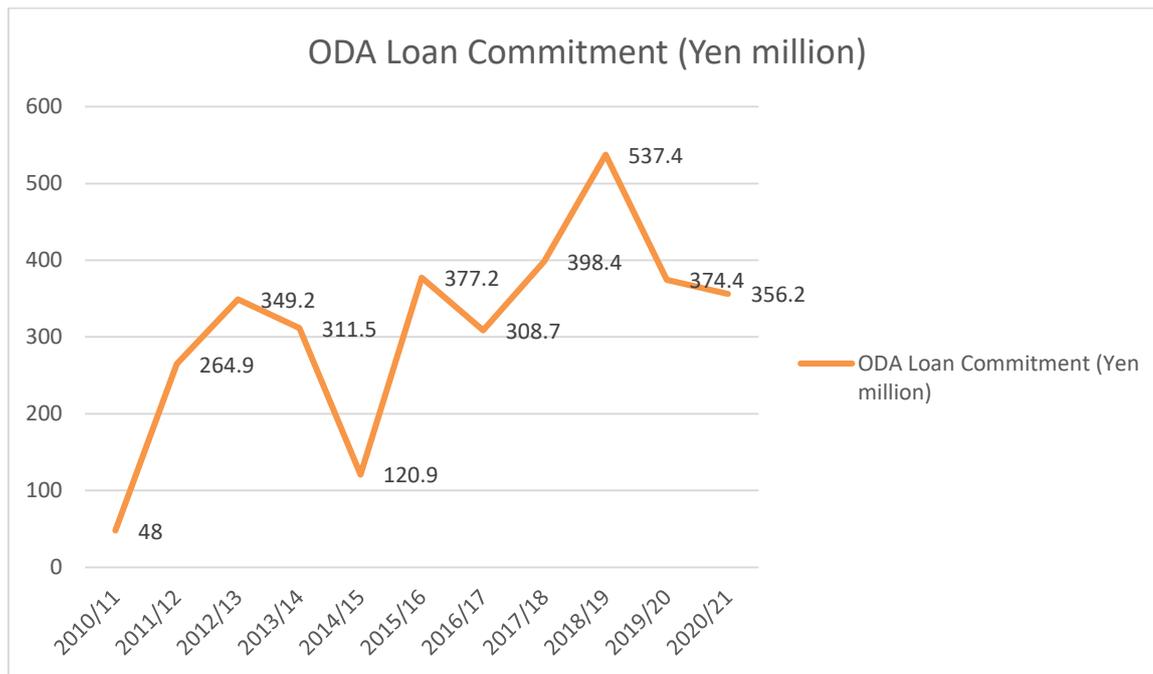


Figure-3: ODA Loan Commitments to India in the period of 2010-2021, Source: (JICA, Operations and Activities in India, FY 2022 - 2023)

## VIII. STI POLICY COMPARISON

The STI policies of India and Japan respectively reflect different approaches that are shaped by the two unique socio-economic contexts in which they operate and seek to achieve their developmental objectives. India's 5th National STI Policy is decentralized, evidence-based and is designed to be inclusive toward attaining technological self-reliance and increasing international competitiveness. It aims at making the necessary grass-root innovations, foster traditional knowledge systems, as well as build a resilient research and development ecosystem, extensively engaging and collaborating among the stakeholders across sectors (DST, 2021).

Whereas the Japanese STI policy has underwent significant changes in the past few decades and, therefore, represents the nation's response to various socio-economic challenges. The policy framework was instituted first in the Basic Law on Science and Technology in 1995. However, this policy framework has been aligned toward an integrated approach leading to the Science, Technology and Innovation Basic Law in 2020. This new framework focuses not only on economic competitiveness but also on social needs, resilience and sustainability.

The core feature of the STI policy in Japan is the mission-oriented innovation policies, which are designed to coordinate government agencies to address well-defined societal challenges. For example, the STI policy is just such an approach, providing a framework for cross-ministerial collaboration on things like automated driving technology. In addition, the new STI Basic Plan targets significant R&D investment avenues with an investment of 120 trillion yen over five years for 'Society 5.0' a vision of a human-centered society harmonizing economic growth with social problem-solving. This way, the new strategy does more to enhance Japan's commitment to harnessing superior technologies such as AI and quantum computing for the betterment of the state and ensure that it leads the world in scientific endeavors (Arimoto, 2024).

## **IX.IMPACT OF TECHNOLOGICAL DIPLOMACY ON INDIAN TECHNO-SYSTEM**

The Techplomacy between India and Japan has deeply impacted the Indian techno-system imbibing a high level of growth, innovation and internationalization. Ensured technology transfer and joint ventures ensured increased technological upgrading of its key sectors infrastructure, information technologies and manufacturing. It has also supported through ODA loans financed by Japan in India to promote infrastructure as well as skill development programs to support the Indian digital economy and the country's workforce expertise. This includes joint initiatives in areas of innovation such as artificial intelligence, smart cities and renewable energy, thereby hastening the process of modernization of technologies in India.

Besides this, the attention to detail and quality in Japan has made the Indian firms better, hence more globally competitive. What the "Make in India" initiative aims to align with India's manufacturing aspiration through advanced semiconductor technology from Japan is to produce a resilient supply chain that will enhance self-reliance and drive economic growth. In addition, co-operation in areas such as 5G technology, AI and space exploration have resulted in knowledge transfer and joint research with India emerging as an important player in high-tech fields. This also means cooperation in the establishment of frameworks for cooperation, like the India-Japan Space Dialogue. Such strategic partnership promotes the technological infrastructure of India while making it an important part of the global supply chains and therefore improving its competitiveness around the world.

## **X.SHORTCOMINGS IN THE JAPANESE APPROACH**

Despite the prestige of the Japanese technology sector for precision and innovation, it has many drawbacks that prevent it from competing at a global level. The population of Japan is growing older very fast; as of 2017, people above 65 years of age account for 27.7 percent of the population (Nakatani, 2019), which can be one reason for the conservative culture of corporations, who usually avoid disruptive innovation in favor of incremental improvements over bold advancement. This, with rigid hiring systems, slows down the speed of decision-making and adaptability in fast-moving technological landscapes (Mavrogenis, 2024). Its domestic markets dependence and minimal orientation to global collaborations also bar it from going further across international boundaries.

Moreover, this sector suffers from dwindling workforce, due to demographic challenges that affect sustainability and scaling. It faces strong international competition are mainly due to poor representation in startups and lower focus on software innovation when compared with hardware (Vogel, 2013). Japanese strength was in hardware with very minimal capabilities in development of the software and their service business did not prove to be competition. Addressing these issues will prove beneficial from cultural to

entrepreneurship, all requiring strong steps that should promote global partnership also for maintaining the competitive lead within the nation.

## XI.FOSTERING TECH ALLIANCE OF FUTURE

The Indo-Japanese techplomacy holds immense untapped potential to shape the future of innovation and economic growth. India is booming in its IT sector and Japan is well ahead in advanced manufacturing and robotics. This will generate a robust ecosystem for the advance movement of technology. There can be further joint ventures that develop in the emerging industries of artificial intelligence, renewable energy and semiconductor production so as to fuel mutual growth in that field for the solution of some global challenges. This alliance will create revolutionary solutions, enhance trade and consolidate geopolitical relationships by leveraging the respective strengths of each nation. This includes an amalgamation of India's potential talent pool and Japan's digital skills and precision engineering as well as R&D capability. The India and Japan's tech partnership's way forward lies in strengthening the existing policy frameworks that help facilitate skill exchange programs as well as encourage private sector partnerships to unlock the full strategic potential of this partnership.

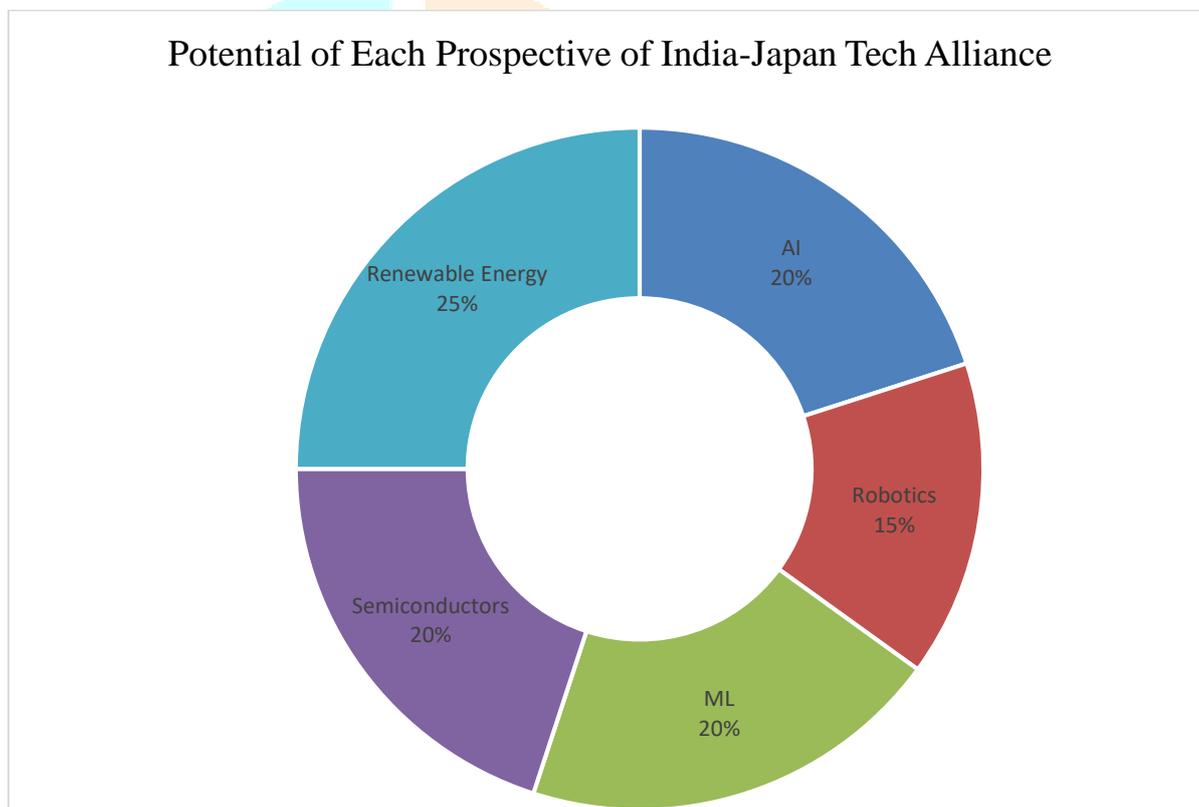


Figure-4: Future Aspects of India-Japan Tech Alliance

The above Figure-4 explains the future prospective of the India-Japan cooperation in the field of technology. The technology evolves to be better persistently thus adaptation to such system is also a skill to nurture in the contemporary times. Certain recent technological developments AI, ML, robotics, and renewable energy.

## XII.CONCLUSION

Technology is revolutionizing every paradigm of life in the world and India and Japan are no exceptions to such developments. Both the countries are working towards leveraging their individual technological innovations to drive collective economic growth, improve quality of life across the countries and thus address global challenges to cyber security.

In India, on the one hand, innovations in digital infrastructure, artificial intelligence and fintech is aiding the education, healthcare and governance sectors and thus uplifting millions of people and fostering inclusivity. The technology diplomacy aided it with more resources, facilities, finances and ease to adapt on ground. The institutional assistance in this segment was backed by architectural governmental assistance supported by private entities to materialize their benefits with positive social impacts.

On the other hand, in Japan, the leadership roles in robotics, precision engineering and renewable energy have established new benchmarks for technological excellence and sustainability. Their industries now more vocal and open to international collaborations and the nexus of corporate fundings is destroyed by themselves. The endeavors are generated within inside which started the wheel of new technological innovations inside their own production cycle. It is streamlining the positive tech aptitude of tech industry to set national priorities at the centre.

The Indo-Japanese technological partnership amplifies these efforts through collaborative ventures in space, semiconductors and other S&T. The Japanese quality and innovation expertise may complement India's vast talent pool and entrepreneurial spirit, thus building a robust foundation for mutual growth. Overall, India and Japan together are shaping a future defined by cutting-edge solutions, sustainable development and global competitiveness, showing how cross-border technological synergy can revolutionize lives and strengthen bilateral ties.

*"Tech for Good, Tech for All"*

### XIII.ABBREVIATIONS

- 5G O-RAN- 5G Open Radio Access Network  
 AHMIN- Asia Health and Medicine Innovation Network  
 AI- Artificial Intelligence  
 AIIMS- All India Institute of Medical Sciences  
 APRSAF- Asia-Pacific Regional Space Agency Forum  
 AYUSHMAN Bharat- Health initiative by the Government of India  
 BPO- Business Process Outsourcing  
 CAGR- Compound Annual Growth Rate  
 CLND Act- Civil Liability for Nuclear Damage Act  
 DAE- Department of Atomic Energy, Government of India  
 DST- Department of Science and Technology, Government of India  
 FDI- Foreign Direct Investment  
 FY- Fiscal Year  
 GCNEP- Global Centre for Nuclear Energy Partnership  
 GDP- Gross Domestic Product  
 HOPE- A Joint Meeting Between India and Japan on S&T  
 IA- Implementation Agreement  
 ICT- Information and Communications Technology

IGNOU- Indira Gandhi National Open University, India

IIT-H- Indian Institute of Technology, Hyderabad

IJSC- Indo-Japan Science Collaboration

IPA- Information-Technology Promotion Agency

iSPIRT- Indian Software Product Industry Roundtable

ISRO- Indian Space Research Organisation

IT- Information Technology

JAES- Japan-India Advanced Energy Systems

JAXA- Japan Aerospace Exploration Agency

JETRO- Japan External Trade Organization

JICA- Japan International Cooperation Agency

JSPS- Japan Society for the Promotion of Science

JST- Japan Science and Technology Agency

LUPEX- Lunar Polar Exploration

MAFF- Ministry of Agriculture, Forestry and Fisheries, Government of India

MAHSR- Mumbai-Ahmedabad High-Speed Rail

MDI- Management Development Institute

MEA- Ministry of External Affairs, Government of India

METI- Ministry of Economy, Trade and Industry, Government of Japan

MEXT- Ministry of Education, Culture, Sports, Science, Government of Japan

ML- Machine Learning

MoC- Memorandum of Cooperation

MoEF&CC- Ministry of Environment, Forest and Climate Change, Government of India

MoFA- Ministry of Foreign Affairs, Government of Japan

MoU- Memorandum of Understanding

NEC- Nippon Electric Company

ODA- Official Development Assistance

S&T- Science and Technology

SAKURA- Student Exchange Program Between India and Japan

SDG- Sustainable Development Goals

SMR- Small and Modular Reactors

SSA- Space Situational Awareness

STI- Science, Technology and Innovation

STS- Science and Technology Studies

TFM- Technology Facilitation Mechanism

UN- United Nations

USD- United States Dollar

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