

Executive Summary

Survey of new industrial areas in India

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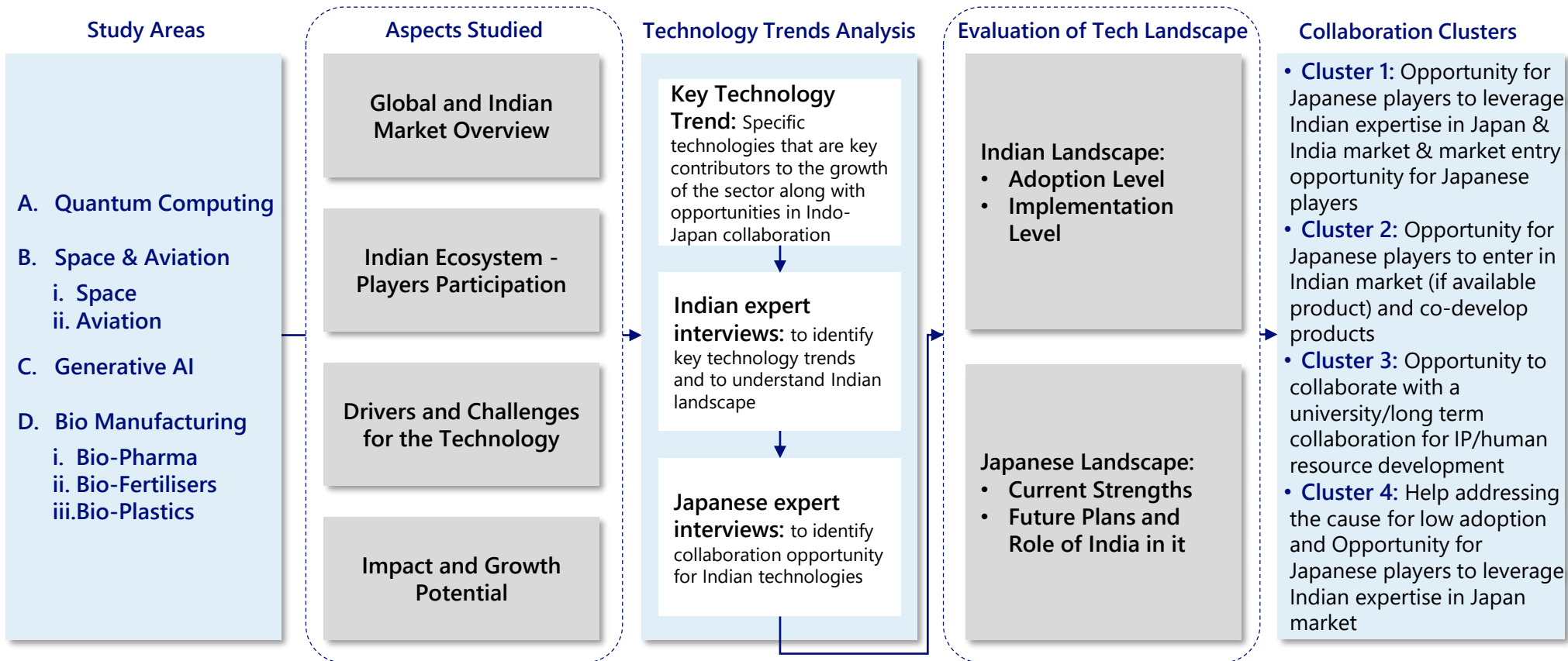


Overview and Objective

Objectives

NEDO and NRI conducted a joint study on 4 technology areas – **Quantum Computing, Space & Aviation, Generative AI** and **Bio-manufacturing**. The study incorporates perspectives from key decision-makers and stakeholders across the Indian ecosystem in order to understand India's strength and opportunities. The study also presents **potential collaboration area between India and Japan** by assessing respective strength and weakness

Overview



Executive Summary

A. Quantum Computing

● High	○ Medium	△ Low
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Study focus area: Across the value chain

Market size Global Market is around **USD 9.27 Bn** and expected to grow to **~USD 26.17 Bn by 2030**. India is expected to contribute **~USD 350 Mn. by 2030**

Key sectors **Energy, Chemicals, Healthcare and BFSI** are expected to be the top adopters of Quantum Computing by 2030

Growth Drivers	Challenges
<ul style="list-style-type: none"> Start-ups in quantum computing 	<ul style="list-style-type: none"> Low enterprise adoption
<ul style="list-style-type: none"> Collaboration between academia and industry 	<ul style="list-style-type: none"> Limited quantum simulators
<ul style="list-style-type: none"> Growing awareness among key industry players 	<ul style="list-style-type: none"> Limited skilled resource

Key Technology Trend	Adoption	Implementation
Processors	△	△
Ion Traps	△	○
Photonics and Optics	○	○
Topological Qubits	△	△
Super-Conducting Qubits	●	○
Cryogenics	△	△
Annealing	○	△
Commercialisation	●	○

Key players (Non-Exhaustive)			
Private org.	Startups	Research org.	Govt. org
HCL Technologies	BosonQ	C-DAC: Centre for Development of Advanced Computing	MeiTY: Ministry of Electronics and Information Technology
Infosys	Qkrishi	C-DOT: Centre for Development of Telematics	GKQCTP: Greater Karnavati Quantum Computing Technology Park
Mphasis	QpiAI Tech		
Tech Mahindra	Quanfluence
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Cluster #	Tech Trends Identified for Indo-Japan Collaboration		
1	● Super-Conducting Qubits	● Commercialization	
2	● Photonics & Optics	● Annealing	
3	● Processors	● Qubit Technologies	● Cryogenics
4	● Ion Traps		

Focus: Across the value chain except Quantum Comms.
Strength: Commercialisation and application solution
Weakness: Infrastructural support for software development

Executive Summary

B. Space & Aviation | i. Aviation

● High	○ Medium	△ Low
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Study focus area: R&D and Sustainable Aviation Fuel

Market size Global Market is at ~USD 2.04 Bn. and is expected grow to ~USD 31.85 Bn. India is currently at ~USD 60 Mn. and is expected to reach ~USD 970 Mn. by 2030

Key sectors This sector is led by **commercial and military** applications with brands like **Mahindra, Tata** and **DRDO** etc. contributing significantly to this field

Growth Drivers	Challenges
<ul style="list-style-type: none"> • Passenger awareness regarding sustainability 	<ul style="list-style-type: none"> • Lack of raw materials for Sustainable Aviation Fuel (SAF)
<ul style="list-style-type: none"> • Secure feedstock and readily available technology 	<ul style="list-style-type: none"> • Procedural delays in approval for certification
<ul style="list-style-type: none"> • International Air Transport Authority (IATA) driving Sustainable Aviation 	<ul style="list-style-type: none"> • Challenges in aircraft electrification

Key players (Non-Exhaustive)			
Private org.	Startups	Research org.	Govt. org
Dynamatic Technologies	Biezel Green Energy	ADE: Aeronautical Development Establishment	ADA: Aeronautical Development
MAPL: Mahindra Aerospace Private	BON V Technology		
Praj Industries	Eplane company	GTRE: Gas Turbine Research Establishment	Bharat Petroleum
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Focus: R&D and Sustainable Aviation Fuel

Strength: Strong availability of selected technologies for generating SAF

Weakness: R&D and raw material availability

Key Technology Trend	Adoption	Implementation
Hydrogen Propulsion	△	△
Electric Propulsion	○	△
Gas Turbine Engines	△	△
Solid State Batteries	△	△
Advanced Engines	△	○
Power to Liquid	○	●
Alcohol to Jet	○	○
High Efficiency Motors	△	△
Fischer Tropsch via Biomass	○	△
Hydrotreated Esters and Fatty Acids (HEFA)	●	△
Airplane design and structure	△	△
Composite Materials	△	△

Cluster #	Tech Trends Identified for Indo-Japan Collaboration
1	● Alcohol-to-Jet
2	● Advanced Engines ● Power-to-Liquid ● HEFA
3	● Hydrogen Propulsion ● Electric Propulsion ● Gas Turbine ● SS Batteries ● High-Efficiency Motors ● Fischer Tropsch ● Airplane Design and Structure ● Composite Materials

Executive Summary

B. Space & Aviation | ii. Space

● High	○ Medium	△ Low
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Study focus area: Heavy & small launch vehicles and applications areas around remote sensing, GPS and satellite communications

Market size Globally ~USD 656 Bn. overall, is expected to be ~USD 1616 Bn. by 2030. Indian market is about ~USD 33 Bn. currently and is expected to be ~USD 354 Bn. by 2030

Indian service market Indian space launch service is expected to be ~USD 270 Mn. for commercial usage and ~USD 1.50 Bn. for government and military usage

Growth Drivers

- Innovation and independence to private sector
- Growth in internet connectivity
- Increase in application area

Challenges

- Limited independent launch solutions
- Limited conduct trial facilities
- Limited talent in space sector

Key players (Non-Exhaustive)

Private org.	Startups	Research org.	Govt. org
Ananth Technologies	AgniKul	IIST: Indian Institute of Space Science and Technology	ISRO: Indian Space Research Organisation
Centum Electronics Ltd.	Astrome Technologies	IITK: Indian Institute of Technology Kanpur	SAC: Satellite Applications Centre
Larsen & Toubro (L&T)	Bellatrix Aerospace
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Key Technology Trend

Key Technology Trend	Adoption	Implementation
Reusable Launch Vehicles	△	△
Remote Sensor Development	△	○
Advanced Engine Systems	○	○
Payload Management Systems	●	●
Launch Vehicles	●	●
3D Printed Launch Vehicles	△	△
Systems Automation	○	○
Advanced Materials	○	○
GPS Aided Navigation	○	●
Satellite Search and Rescue	○	●
Disaster Management Support	●	●



Focus: Heavy and Small Launch Vehicles and Applications
Strength: Strong software and infrastructure
Weakness: Sensor for remote sensing, low participation from start-ups and private bodies

Cluster # Tech Trends Identified for Indo-Japan Collaboration

1	<ul style="list-style-type: none"> • Remote Sensor Development • Payload Management • Systems Automation • GPS-Aided Navigation • Disaster management support 	<ul style="list-style-type: none"> • Advanced Engine Systems • Launch Vehicles • Advanced Materials • Satellite aided search & rescue
3	<ul style="list-style-type: none"> • Reusable Launch Vehicles 	<ul style="list-style-type: none"> • 3D Printed Launch Vehicles

C. Generative AI

● High	○ Medium	△ Low
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Study focus area: Across the value chain

Market size Global Market at present is ~USD 17 Bn. and is expected to be ~USD 109 Bn. by 2030. India is currently contributing ~USD 1.1 Bn. and expected to be ~USD 7.6 Bn by 2030

Leading sectors Leading industries that are expected to utilise GenAI technology- **IT&Telecom, BFSI, Healthcare, Automotive**

Growth Drivers	Challenges
• Lower cost of applications	• Limited data & governance framework
• Growing Internet economy	• Limited funding
• Increasing demand for IT clients	• Limited talent in AI research

Key Technology Trend	Adoption	Implementation
Ethical AI	△	○
RAG	△	●
Verticalisation	△	●
Multi modal models	○	△
Trust layer	△	△
Data localisation	△	○
Cloud integration	○	○
Generative design	△	△
Bots in workforce	△	△

Key players (Non-Exhaustive)

Private org.	Startups	Research org.	Govt. org
TCS	Beatoven.AI	IIT Bombay	MEITY
Tech Mahindra	Blend	IIT Delhi	
Wipro	Codemate	IIT Madras	
Reliance Jio	brahmGAN	IIT Guwahati	
...	

Cluster #	Tech Trends Identified for Indo-Japan Collaboration
1	• Cloud integration
2	• Multi modal models
3	• Trust layer • Generative design • Bots in workforce
4	• Ethical AI • RAG • Verticalisation • Data localization

Focus: Gen AI value chain except training infrastructure

Strength: Creating application on Gen AI and LLMOPs (existing expertise)

Weakness: LLM (Large Language Model) research

Executive Summary

D. Bio-manufacturing | i. Bio-Pharma

● High	○ Medium	△ Low
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Study focus area: Across the value chain

Market size

Globally the market is ~USD 517 Bn. and is expected to be ~USD 652 Bn. by 2027. Indian market is at ~USD 24.8 Bn. and is expected to be ~USD 35.3 Bn. by 2027

Growth rate

Indian pharma bio-manufacturing market is expected to grow at ~13% which is higher than the global average of ~8%

Growth Drivers

- Rising chronic diseases
- Rising income & increased healthcare spending
- Govt. initiatives

Challenges

- Limited infrastructure
- Quality concern, particularly for imports
- Raw material dependence

Key Technology Trend

Adoption

Implementation

Genomics & personalized medicine	△	○
Cell and gene therapy	○	○
Bio-printing and tissue engineering	△	△
Immunotherapy	●	●
Monoclonal antibodies	●	●
mRNA	○	○
Continuous manufacturing	●	●

Key players (Non-Exhaustive)

Private org.	Startups	Research org.	Govt. org
Bharat serums & vaccines	Eyestem	ICMR (Indian Council of Medical Research)	BIRAC*
Biocon	ImmunoACT		BIBCOL (Bharat Immunological & Biological Corp)
Dr. Reddy's Lab	Zumutor	JNCASR (Jawaharlal Nehru center for advanced scientific research)	Hindustan Antibiotics Ltd
Enzene biosciences	Bugworks		..
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Cluster # Tech Trends Identified for Indo-Japan Collaboration

- | | |
|---|--|
| 1 | <ul style="list-style-type: none"> • Cell & gene therapy • Immunotherapy advancements • Monoclonal antibodies • Continuous manufacturing |
| 3 | <ul style="list-style-type: none"> • Genomics and personalized medicine • Bio-printing and tissue engineering |
| 4 | <ul style="list-style-type: none"> • mRNA |



Focus Area: Across the value chain

Strength: Manufacturing and R&D is a strength to cater to local market

Weakness: Raw material supply is relatively a area of weakness due to dependence on foreign imports

D. Bio-manufacturing | ii. Bio-fertilisers

⊙ High	○ Medium	△ Low
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Study focus area: Across the value chain

Market size Globally it is around ~USD 8.8 Bn. and is expected to be ~USD 13.27 Bn. by 2027; Indian market is at ~USD 543 Mn. and is expected to be ~USD 838 Mn. by 2027

Growth rate Indian bio-fertilisers market is expected to grow at ~16%, similar to the historical growth rate

Growth Drivers	Challenges
<ul style="list-style-type: none"> Increased demand for organic produce Increasing awareness about farming practises Govt. initiatives 	<ul style="list-style-type: none"> High target specificity & cost Competition from chemical counterparts Low current awareness & usage

Key Technology Trend	Adoption	Implementation
Advanced formulations and strain improvements	△	⊙
Mixed inoculants	⊙	⊙
Biofilm fertilizers	○	△
Biostimulants & bio enhancers	⊙	⊙
Waste utilization	△	○
Smart delivery systems	○	○
Precision agriculture integration	○	○
Blockchain traceability	△	△

Key players (Non-Exhaustive)

Private org.	Startups	Research org.	Govt. org
Biostadt India	Cytolife agritech	Indian Council of Agricultural Research	BIRAC*
Coromandel International			Gujrat state fertilisers
IFFCO (Indian Farmers Fertilizer Cooperative Limited)	Samarth Biotech	Indian Agricultural Research Institute	NCOF (National Center for Organic Farming)
...

Cluster #	Tech Trends Identified for Indo-Japan Collaboration
1	<ul style="list-style-type: none"> Mixed inoculants Biostimulants & bio enhancers
2	<ul style="list-style-type: none"> Biofilms fertilizers Smart delivery systems
3	<ul style="list-style-type: none"> Precision agriculture integration Blockchain traceability
4	<ul style="list-style-type: none"> Advanced formulations & strain improvements Waste utilization

Focus area: Across the value chain

Strength: Manufacturing is a strength to cater to local market

Weakness: R&D and raw material supply are relatively areas of weakness

*BIRAC - Biotechnology Industry Research Assistance Council

D. Bio-manufacturing | iii. Bio-Plastics

● High	○ Medium	△ Low
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Study focus area: Across value chain

Growth Drivers	Challenges
<ul style="list-style-type: none"> Increasing demand for bio-manufactured products 	<ul style="list-style-type: none"> Limited penetration in rural areas
<ul style="list-style-type: none"> Abundance of biomass resources 	<ul style="list-style-type: none"> Higher cost and inferior properties than plastics
<ul style="list-style-type: none"> Government initiatives 	<ul style="list-style-type: none"> Import of most of raw materials

Key players			
Private org.	Startups	Research org.	Govt. org
Greendot Biopak	Symphony Polymers	Center of excellence in sustainable polymers - IIT Guwahati	BIRAC*
...	Zerocircle		
	Greendot	...	
	Resqpol		
	...		

Key Technology Trend	Adoption	Implementation
Nanotech in bioplastics	△	○
Bioplastic films and coatings	○	●
3D printed bioplastics	○	●
Bio-based feed stock	△	●
Bioplastics recycling	△	●

Cluster #	Tech Trends Identified for Indo-Japan Collaboration
1	<ul style="list-style-type: none"> Bioplastic films and coatings 3D printed bioplastics
4	<ul style="list-style-type: none"> Nanotech in bioplastics Bio-based feed stocks Bioplastics recycling

Focus area: All across value chain
Strength: Manufacturing is current strength in India
Weakness: Raw material supply and R&D are current weakness

*BIRAC - Biotechnology Industry Research Assistance Council



**Envision the value,
Empower the change**