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Knowledge is power once again.

Building a financial launchpad for frontier technologies for BRICS

2026

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Building Financial Launchpad
for Frontier Technologies for BRICS

Ilya Ivaninsky, Sergey Panfilov, Aleksandr Raksha

2026

Foreword

The global economy stands at a critical crossroads, defined by a rapid transition towards frontier technologies that are fundamentally reshaping industries, societies, and the nature of national competitiveness. As the New Development Bank (NDB) convenes for its annual meeting in the Russian Federation, the urgency of bridging the technological divide has never been more apparent. This report was prepared by the Ministry of Finance of the Russian Federation and Central University to coincide with this milestone event, offering a strategic framework for the future of innovation across the BRICS ecosystem.

For decades, the promise of emerging economies was rooted in growing populations and vast natural resources. However, in the current era, the true measure of a nation's resilience is its ability to master deep tech—high-impact, science-based solutions that solve the world's most intractable challenges. While our member states possess unparalleled human potential and market scale, there remains a persistent implementation gap between scientific discovery and industrial leadership.

Our research indicates that the path to technological sovereignty is hindered not by a lack of ambition but by systemic structural bottlenecks. Many nations remain caught in a cycle where significant intellectual output fails to transition into global market standards. These challenges are multifaceted, ranging from fragmented financing landscapes and short-term strategic horizons to the absence of robust exit environments for high-growth ventures. Without a cohesive financing stack that supports a technology from its laboratory inception to global scaling, even the most promising breakthroughs remain siloed.

To address these imbalances, this report proposes a shift from isolated national efforts towards a synchronised international architecture. We explore the necessity of a lifecycle-based approach to investment, where public-private synergies de-risk early-stage research and integrated capital markets provide the liquidity necessary for national champions to emerge. By pooling our strengths and harmonising our regulatory environments, we can transform a collection of individual markets into a global engine for high-value creation.

The findings presented here are intended to catalyse a high-level dialogue on how the BRICS and NDB community can move from being consumers of foreign technology to becoming the strategic architects of the next industrial era. The transition will require a long-term commitment to smart governance and a fundamental reimagining of how we fund the future.

It is our hope that this report serves as a vital resource for policymakers, investors, and innovators alike as they navigate the complexities of this new technological frontier.

Enjoy the read.

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1 Introduction: Why Technology Leadership Matters

Technological development is one of the main determinants of economic growth. Countries that moved from developing to developed status did so not only through capital accumulation but through productivity and competitiveness growth. Since the middle of the 20th century, five countries have made that transition: Japan, Israel, South Korea, Singapore, and Taiwan. Their experience suggests that technology was not a side factor but one of the main drivers of accelerated catch-up growth. This growth was fueled by major R&D spending (above 2–3% of GDP[1]) and the venture capital market (growth of at least 15% per year) focusing on deep tech. Deep tech refers to hard-to-replicate solutions based on scientific and engineering advances requiring significant investment, capable of transforming industries and creating new markets.

BRICS and NDB Shareholders bring together >50% of the world's population, around 42% of global GDP at PPP, and a disproportionate share of strategic resources, including roughly 72% of rare earth reserves.

BRICS and other NDB shareholders (referred to as BRICS NDB or member states in the report) have substantial unrealised potential: these groups bring together >50% of the world's population, around 42% of global GDP at PPP[2], and a disproportionate share of strategic resources, including roughly 72%[3] of rare earth reserves. Yet in most member states, this scale is still not matched by sufficient technological development. As a result, the bloc's economic weight is not supported by productivity, higher value-added output, and income per capita.

Most member states (with notable exception of China) lag behind global leaders in most aspects of technology development: R&D intensity stands at 0.2–1.5% of GDP versus 3.2–6.4% for technology leaders[4], venture capital (VC) is under 0.1–0.3% of GDP versus 0.6–1.1% in the leading countries. Member states demonstrated strong indicators in the financial markets in 2025: 45–50% of all world's IPOs of technology companies and 35–40% of the volume of funds raised. However, around 90% of this result comes from two countries—China and India[5]. As a result, for most of the group's countries, even where scientific capability exists, it is often not converted into scalable products, strong companies, and exportable technologies.

It is necessary to transform the approach to technological development management. The primary tool is the deployment of capital in the priority sectors paired with development of an end-to-end toolkit for financing technologies from the state of an idea to exit on financial markets.

To fix the above-mentioned imbalances, it is necessary to transform the approach to technological development management. The primary tool is the deployment of capital in the priority sectors paired with development of an end-to-end toolkit for financing technologies from the state of an idea to exit on financial markets. The toolkit should include local and international levels and should be based on three principles:

- countries should focus on a limited number of tech domains priorities;
- support measures and financing tools should be tied to the technology life cycle stage;
- national efforts should be reinforced by international mechanisms that expand markets, reduce duplication, and improve access to long-term smart capital.

The rest of the report is structured as follows. Part 2 defines deep tech and its importance. Part 3 evaluates the state of deep tech development in the member states. Part 4 provides an analysis of the main challenges currently existing in the member states. Part 5 zooms in on financial infrastructure as the overarching challenge in the market. Part 6 proposes the solution for the financing challenge. Part 7 provides the assessment of an impact. Part 8 concludes.

2 Deep Tech: What It Is and Why It Is Important

Deep tech refers to a specialised category of innovation fundamentally rooted in substantial scientific advancements and engineering breakthroughs. Unlike general tech, which prioritises business model optimisation or the consumer-facing application of existing technologies, deep tech is characterised by its focus on resolving intractable technical challenges.

Deep Tech vs General tech

The difference between deep tech and general tech can be defined by 5 metrics[6]:

- **Temporal horizons and R&D cycles:** general tech maintains a rapid time to market. Conversely, deep tech requires an extended R&D life cycle, typically spanning 5–15 years from laboratory inception to commercial viability.
- **Capital intensity and allocation:** deep tech ventures are characterised by extreme capital requirements during the pre-revenue phase. Empirical evidence indicates that these enterprises require, on average, 1.5 times more capital than traditional software start-ups to achieve equivalent initial revenue milestones.
- **Competitive moats and IP valuation:** while general tech often relies on network effects or brand equity, deep tech value is anchored in “scientific moats”. These consist of hard-to-reproduce intellectual property (IP) and proprietary engineering breakthroughs that provide formidable, long-term barriers to entry and sustainable competitive advantages.
- **Market risk:** in general tech, uncertainty lies mainly in commercial execution—whether the product wins adoption, monetises effectively, and scales in a competitive market where demand already exists. In deep tech, demand itself may remain uncertain, since market formation often depends on the technology first proving its industrial feasibility and practical relevance.

Deep Tech vs General Tech across five key metrics

Deep Tech

General Tech

Temporal Horizons and R&D Cycles

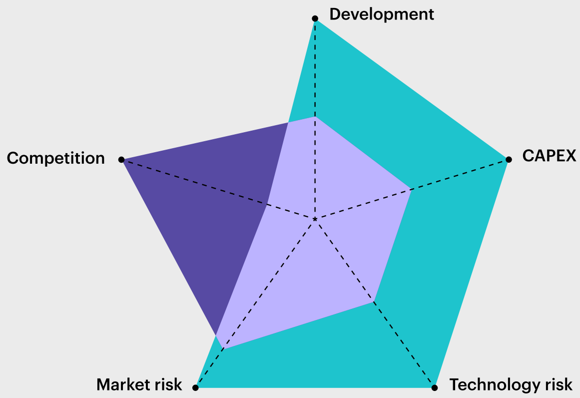
Deep tech: long development cycle

General tech: faster time to market

Competitive Moats and IP Valuation

Deep tech: unique product

General tech: large number of competing solutions



Capital Intensity and Allocation

Deep tech: substantial CAPEX for R&D

General tech: low development costs

Market Risk

Deep tech: uncertain market

General tech: strong existing demand

Technology Risk

Deep tech: technological breakthrough or leap

General tech: proven technologies

- **Technology risk:** in deep tech, the core uncertainty is whether a scientific hypothesis can be translated into a stable, scalable, and economically viable product. In general tech, technological feasibility is usually less central, since products are more often built on proven technologies.

The deep tech landscape is organised into distinct but increasingly interconnected domains[7]:

1. **Artificial intelligence (AI):** foundational models, neural architectures, and specialised hardware.
2. **Robotics & autonomous systems:** cyber-physical systems and industrial automation.
3. **Life sciences & biotechnology:** synthetic biology, genomic editing, and personalised therapeutics.
4. **Agritech:** resilient agricultural systems and precision biotechnologies.
5. **New materials & nanotechnology:** superconductors, graphene, and carbon-negative composites.
6. **Mobility & advanced transportation:** autonomous logistics and high-density energy storage.
7. **Energy tech:** fusion energy, hydrogen ecosystems, and solid-state battery technology.
8. **Space tech:** orbital manufacturing and reusable launch vehicles.
9. **Distributed computing & DLT:** decentralised architectures and edge-computing infrastructure.
10. **Quantum technologies:** quantum sensing, secure communication, and fault-tolerant computing.

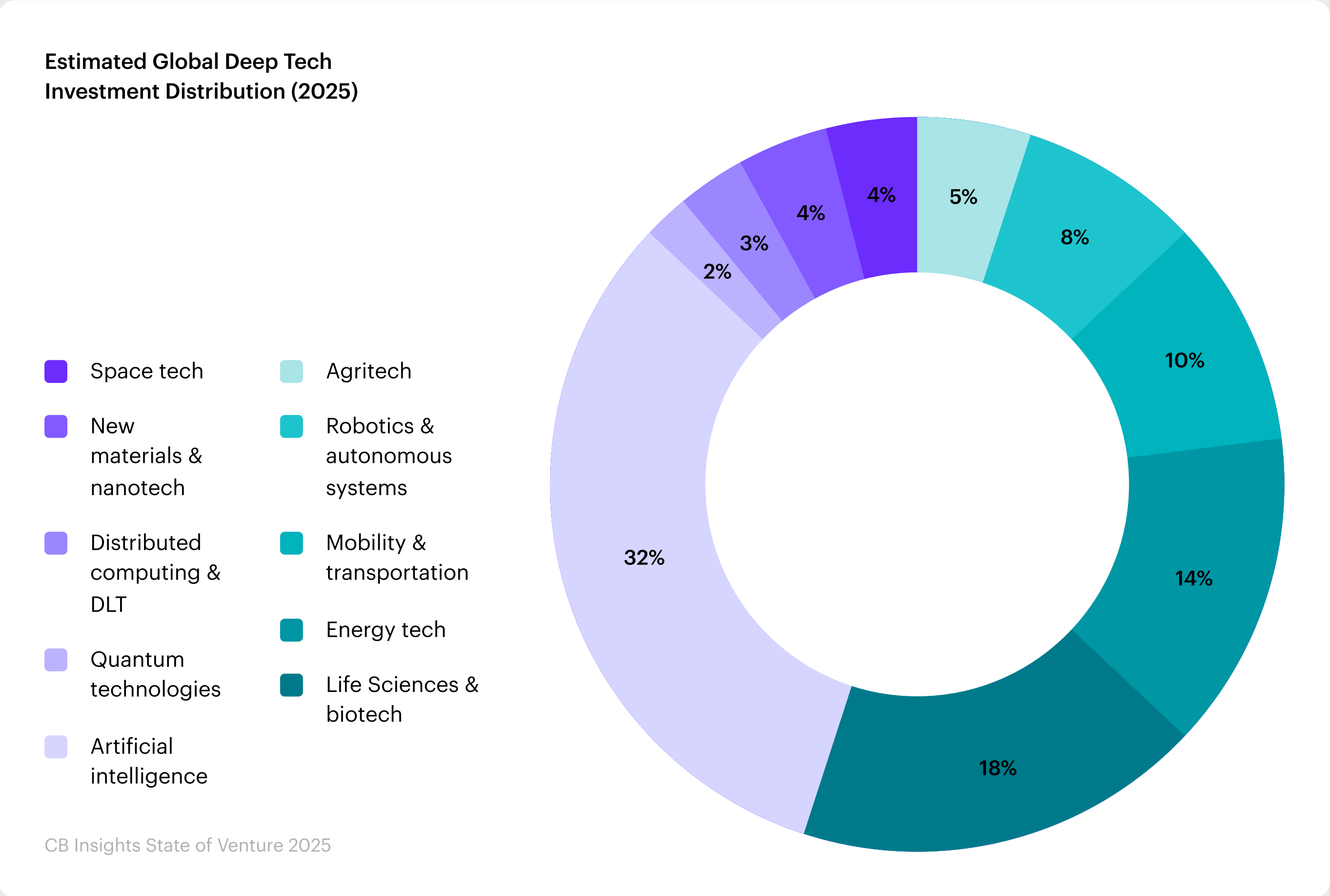
Artificial intelligence (AI) dominates with 32% of deep tech investment, driven by the massive surge in large language models (LLMs) and specialised AI hardware.

The investment landscape in deep tech[8] is heavily prioritised towards foundational intelligence and sustainability:

- **AI (32%):** driven by the massive surge in large language models (LLMs) and specialised AI hardware (ASICs/GPUs).
- **Life sciences (18%):** focused on synthetic biology and AI-driven drug discovery, which has significantly reduced the R&D timeline for therapeutics.
- **Energy tech (14%):** bolstered by national commitments to the energy transition, specifically in hydrogen ecosystems and solid-state batteries.
- **Emerging clusters:** quantum technologies and distributed computing currently hold smaller shares but are categorised by high capital intensity per deal, indicating their early-stage, high-risk nature.

Innovation increasingly occurs at the domains intersections. For instance, embodied AI combines AI and robotics.

Innovation increasingly occurs at the domains[9] intersections. For instance, embodied AI combines AI and robotics, where machine intelligence is integrated into physical entities capable of environmental interaction. Similarly, biocomputing merges life sciences and distributed computing to leverage biological structures for high-density data storage.



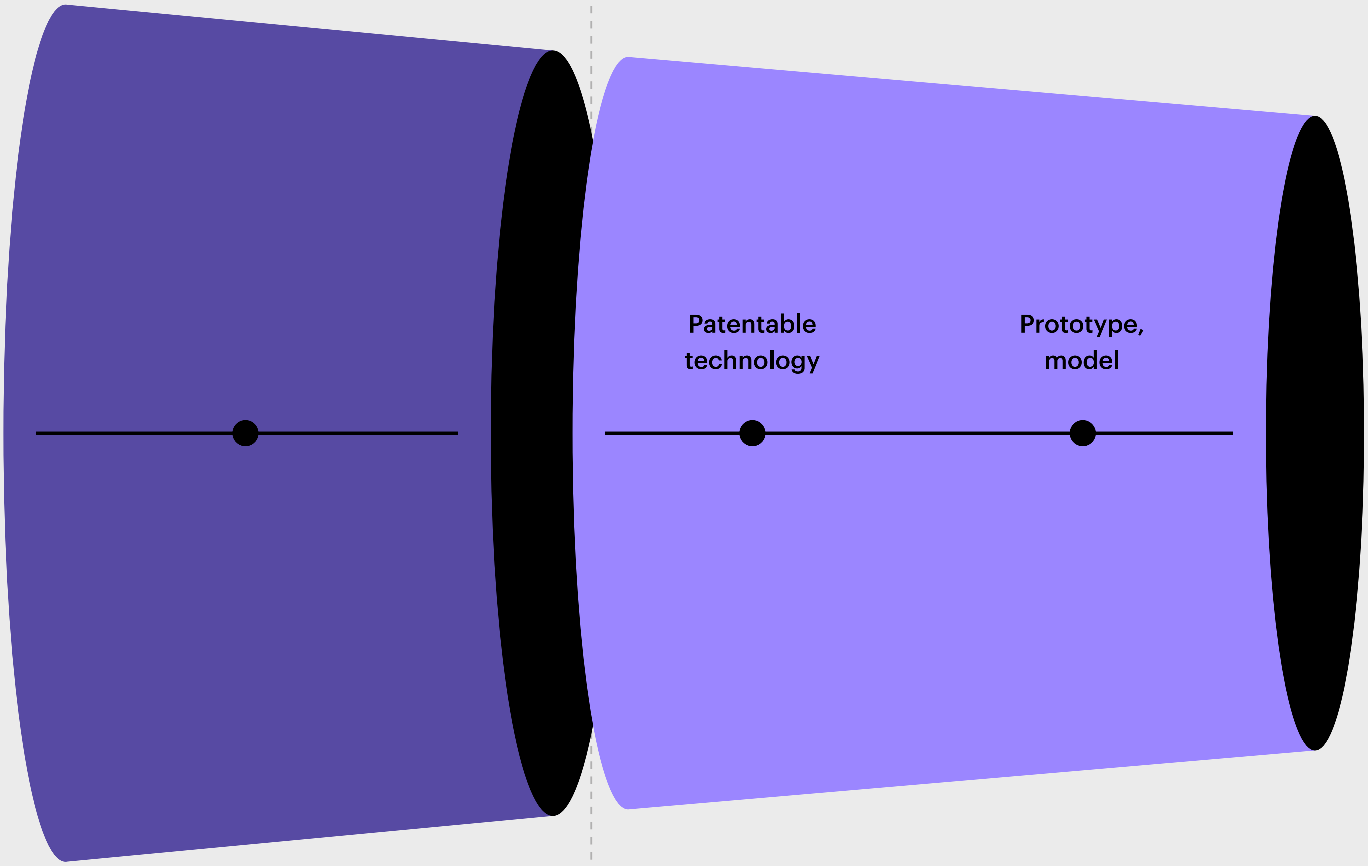
The Technology Development Funnel

A country's technological development can be analysed using a funnel framework consisting of 4 stages: selection of priority domains, funding of R&D, funding of start-ups by venture capital (VC), and the financial market for funding IPO and M&A.

A country's technological development can be analysed using a funnel framework consisting of 4 stages: selection of priority domains, funding of R&D, funding of start-ups by venture capital (VC), and the financial market for IPO and M&A. Many ideas are generated in the early stages, but only a limited number reach the prototype stage, market launch, and commercial scale. This matters for technology-based economic growth, since financing needs, risk profiles, and the roles of the key stakeholders differ substantially across stages. A single generic support mechanism, therefore, cannot work across the full pipeline.

Key steps to build a tech business

Strategic Governance & Priority Selection	Research & Development



Strategic Governance & Priority Selection

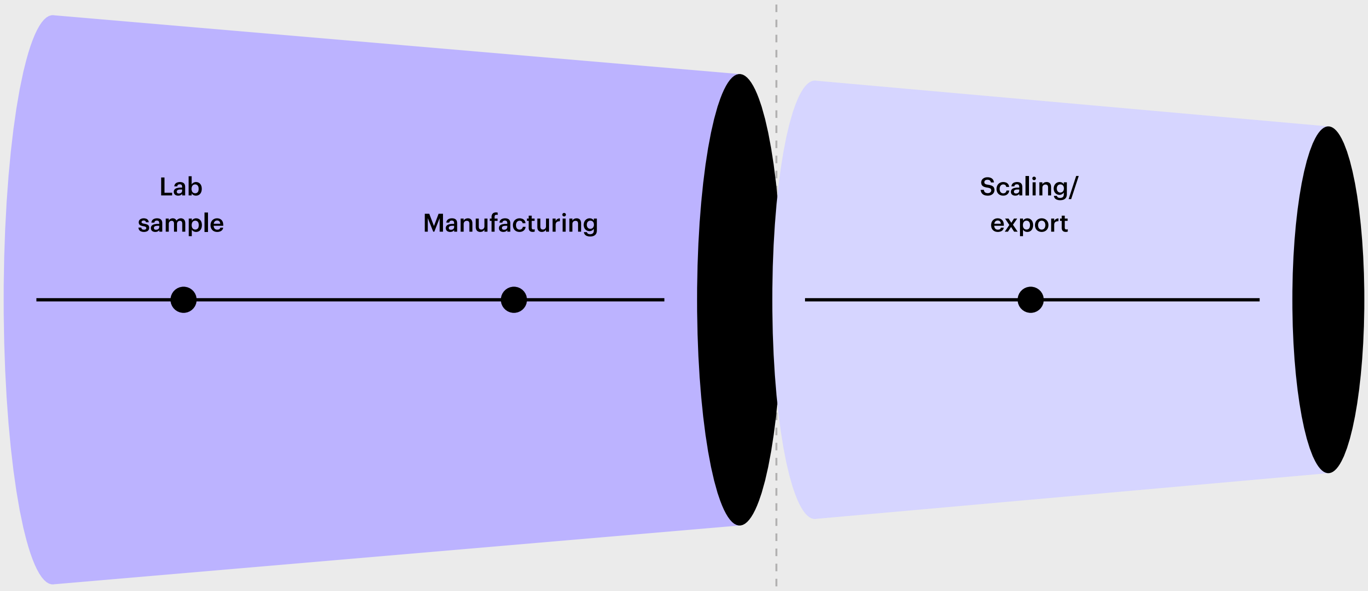
- Key priorities defined on product-based strategic vision

Research & Development

- A formulated idea and basic principles
- A conducted market analysis
- Developed promising tech solution
- A developed, promising tech solution
- A conducted preliminary patent analysis
- A created, simplified prototype, a confirmed concept
- A developed IP protection strategy

Venture Capital Market

Financial Market



Venture Capital Market

- A produced laboratory sample
- Key technological components validated under real-world conditions
- Filed patents
- Finalization of development and testing of a fully functional solution in operational conditions
- Correction of minor defects
- Actual/real-world use of the product in its final form and under real-world conditions
- Preparation for serial production

Financial Market

- Scaling production and capturing a significant share of the domestic market
- Integration with related players in the technology chain, incl. M&A
- Product development and launch of spin-off projects
- Entering export markets
- Global scaling

The initial stage requires selection of priority technologies. For most countries, this means selecting up to five deep tech priorities.

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For most countries, this means selecting up to five deep tech priorities.
Only the largest economies can sustain a broader set.

The technological development level of a country is therefore assessed using four groups of indicators, corresponding to the respective stages of the technology funnel:

1. **Strategic governance & priority selection** define key goals, domains, industries, and approaches to the regulation and management of technological development.
2. **R&D performance** is assessed through the volume and effectiveness of R&D spending and the number of patents generated by the scientific community.
3. **The VC market**, as the key infrastructure for technology commercialisation, is assessed through the number, volume, and dynamics of transactions involving VC.
4. **The financial market** is assessed using public data on the number and volume of IPOs by technology companies, acting as national champions, and share of tech exports.

Investment Dynamics

As of 2025, deep tech consistently captures 28–32% of total global venture capital.

The evolution of deep tech funding reflects its transition from state-led R&D to a dominant pillar of the global venture capital (VC) ecosystem.

- Following more than a decade of incubation, global deep tech funding in late 2021 reached approximately $46 billion quarterly, accounting for 21% of total VC volume[10].
- Despite a global contraction in general tech investment after 2021, deep tech exhibited resilience. By 2023, its share of global VC rose to 26%, bolstered by "mega-rounds" in foundational AI[11].
- As of 2025, deep tech consistently captures 28–32% of total global venture capital[12]. The investment thesis has shifted towards "tangible impact", prioritising technologies that address systemic global challenges such as carbon neutrality, demographic shifts, and geopolitical security.

Every $1 invested in this sector is projected to generate $11 in GDP growth.

Deep tech serves as a decisive economic multiplier; every $1 invested in this sector is projected to generate $11 in GDP growth[13]. Deep tech is the essential tool for countries transitioning from technological consumers to the strategic architects of the next industrial era.
By formalising deep tech as a primary object of governance and capital allocation, the BRICS NDB countries can convert their vast human capital pool into a sovereign engine for high-margin value creation and long-term national resilience.

3 Current Position of BRICS in the Technology Landscape

We assess the current technological position of BRICS NDB countries in the global landscape through the lens of the technology development funnel described above. The key questions are: a) how much scientific, financial, and industrial capacity the group possesses and b) how effectively that capacity is converted into high-value intellectual property, technology companies, scale-ups, and capital market launches—the progression along the funnel.

The analysis, combines two perspectives: where the main bottlenecks emerge along the funnel and how differences in national profiles shape the group's overall technological position.

At the same time, the group cannot be treated as a single technological system: its members differ significantly in strategic profiles, technological strengths, institutional maturity, and readiness for multilateral co-operation. The analysis, therefore, combines two perspectives: where the main bottlenecks emerge along the funnel and how differences in national profiles shape the group's overall technological position.

Overall Status and Conversion along the Technology Development Funnel

The current position of BRICS and NDB shareholders is assessed along the 4 steps of the technology development funnel described in part 2.

→ **Strategic Governance & Priority Selection**
Typically, technology leaders identify up to 5 strategic domains[14] for development over a 20-25-year period[15], while most BRICS NDB countries have broader strategies for an average of 5 years. This discrepancy creates a risk of permanent technological gap, necessitating a shift towards more niche specialisation and long-term investment horizon.

Global R&D spending reached nearly USD 2.9 tn in 2024. The United States and China together account for almost 55% of the total world R&D spendings.

→ **R&D Spending and Effectiveness**
Global R&D spending reached nearly USD 2.9 tn in 2024[16]. The United States and China together account for almost 55% of the total world R&D spendings with other BRICS NDB countries contributing less than 5%. China is the only BRICS country above the 2% of GDP threshold, at 2.7%[17]. China also leads in annual patent applications and spends roughly USD 0.43 mn per patent[18]—level comparable with leaders such as South Korea and Japan. Among the BRICS NDB countries, India shows comparable efficiency level with others lagging behind.

→ **Venture Capital Market**
Global venture investment reached almost USD 470 bn by the end of 2025[19]. The United States holds around 60% of the market; China remains second at roughly USD 35–40 bn. Most BRICS members stay below 0.05–0.1% of GDP in venture intensity vs 0.6–1% of GDP for technology leaders[20]. Without a deeper venture layer, R&D output will not scale into companies.

In the leading technology economies, high-tech exports account for more than 40–50% of total exports, whereas across most BRICS countries the share is significantly lower.

→ **Financial Market**
By the end of 2025, global IPO activity had recovered to about 1.3 thousand deals and USD 171.8 billion in proceeds, with technology, media, and telecommunications accounting for 21% of the total[21]. Within BRICS NDB countries, China already offers a meaningful market for tech IPOs, while India is emerging as a second growth center. However, this remains an exception rather than the norm. Furthermore, in the leading technology economies, high-tech exports account for more than 40–50%[22] of total exports, whereas across most BRICS countries the share is significantly lower, reflecting weaker commercialisation depth and competitiveness. Most BRICS NDB markets do not provide a robust exit path for investors, weakening incentives across the financing funnel.

For more insights we evaluate conversion rates between steps of the funnel using the benchmarking with global tech leaders:

Comparative conversion rates across the Technology Development funnel

Metric / funnel stage	China	BRICS (excl. China)	New NDB shareholders	Tech leaders (benchmark)
R&D to patents (patents per $1B R&D spent)[23]	850+	250–300	<150	350–400
Patents to start-ups (IP-to-business conversion)[24]	~1.2%	~0.8%	<0.3%	~4.5%
Patent quality index (triadic / high-impact)[25]	30%	15–20%	<10%	65%
Start-ups to unicorns (% success rate)[26]	0.06%	0.03%	<0.01%	0.08%
Unicorns to IPO (exit coefficient)[27]	18–20%	8–10%	<5%	20–25%

The BRICS-NBD group has scale but insufficient intensity, uneven research quality, shallow VC outside a few hubs, and weak exit infrastructure.

Taken together, the analysis points to a pattern: the group has scale but insufficient intensity, uneven research quality, shallow VC outside a few hubs, and weak exit infrastructure.

The main gap between all groups and the global leaders (the US, South Korea, Japan, etc.) is most clearly visible in the patent-quality and IP-to-business conversion layers. Leaders may produce fewer patents per dollar than China, but those patents are significantly more likely to become the basis for products, standards, and scalable firms ultimately serving as the essential foundation for the emergence of national champions—a patent quality index of 65%, compared to 30% in China and 15–20% in the broader BRICS group. For China, the main challenge is therefore quality deepening; for the rest of the BRICS and NDB cohort, the problem is both weaker quality and lower resource density.

Comparative Analysis of BRICS and NDB Shareholders Profiles

Overall Countries' Maturity Levels

While the member states as a whole show several gaps vs economies leading in technological development, there is arguably even more heterogeneity among the members.

We evaluate the maturity of national technology development systems using the same core metrics for each step of the funnel which measures strategy horizon, capital depth, research effectiveness, demand density, and institutional quality.

The maturity distribution shows that China is the only country among the member states that consistently approaches advanced status across the full funnel, while the rest of the group remains highly differentiated and, in most cases, incomplete in at least one critical stage.

Declared Deep Tech Priorities

Most BRICS countries declared several deep tech priority domains. The analysis suggests a correlation between economic scale and the breadth of priority portfolios. Larger technological powers, such as China, Russia, India, and Iran, currently maintain more diversified portfolios, often spanning 6–8 active vectors.

Such breadth can lead to resource dispersion. Without concentration around a narrower set of objectives, even large economies risk diluting their R&D impact and failing to reach leadership in any frontier domain.

Without concentration around a narrower set of objectives, even large economies risk diluting their R&D impact and failing to reach leadership in any frontier domain.

More focused strategic profiles are visible among several newer NDB participants. The targeted development model seen in countries such as Algeria, Ethiopia, and Egypt aligns universal domains with one or two high-relevance domestic sectors.

Beyond the individual country level, the analysis shows three groups of technologies that are the most widespread: artificial intelligence (AI), life sciences (biotechnology and healthcare), energy tech (energy technologies). In parallel, the Latin American cluster (Brazil, Colombia, and Uruguay) displays a regional emphasis on agritech and adjacent domains. These technologies may act as a stable foundation for multi-country co-operation.

The other domains remain relatively scattered among the countries. On the one hand, this is a challenge as it limits co-operation. On the other hand, it presents an opportunity as it allows the countries to form blocks and realise synergetic effects.

Maturity Assessment of National Technology Management Systems

Dimension	Criteria	Maturity Level: Initial	Maturity Level: Basic/ middle	Maturity Level: Advanced/ best in class	Conclusions
1. Priorities	• Strategic specialisation (limited number of priorities) • Long-term tech development strategy for 20–25 years • End-to-end national governance model	Egypt, Colombia, Uzbekistan, Ethiopia, Algeria, Bangladesh	India, Russia, Uruguay, South Africa, Brazil, Indonesia, Iran, UAE	China	Develop a long-term strategic vision at both the national and group levels, taking into account the specialisation of countries and the synergies between them
2. R&D spending	• R&D spending share of GDP, % • Share of private R&D financing, % • CAGR of R&D spending, %	Indonesia, Egypt, Uzbekistan, Iran, Uruguay, Colombia, Bangladesh, Algeria, Ethiopia	India, Russia, Brazil, South Africa	China, UAE	Increase R&D spending to above 2% of GDP and ensure a share of private co-financing of at least 50% for all countries in the group
3. R&D effectiveness	• Number of patent applications • Cost per 1 application • Number of researchers per 1,000 employees • Research intensity (patents/researchers) • Research quality index	Brazil, Indonesia, Egypt, Colombia, Uzbekistan, Ethiopia, Algeria, Bangladesh	India, Russia, Uruguay, South Africa, Iran, UAE	China	Increase the density of the research and development base and the efficiency of R&D spending at both the national and group levels
4. The venture market	• VC market volume, USD • Number of deals • VC market CAGR, % • Number of unicorns • Founder retention index, %	Russia, South Africa, Iran, Uzbekistan, Egypt, Uruguay, Algeria, Bangladesh, Ethiopia	India, Indonesia, Colombia, Brazil, UAE	China	Develop a common venture capital market for BRICS and its partners based on national currencies and multilateral cooperation, increasing the market size to 0.7–1% of the group's GDP
5. Financial market	• Number of tech IPOs • Volume of funds raised, USD • Share of global IPO market, % • Share of tech export, &	Russia, South Africa, Iran, Uzbekistan, Egypt, Uruguay, Brazil, Bangladesh, Algeria, Colombia, Ethiopia	India, Indonesia, UAE	China	Create a common multilateral financial market to develop national champions based on unicorns and big tech
Overall maturity		Egypt, Colombia, Iran, Uzbekistan, Algeria, Bangladesh, Ethiopia	India, Indonesia, Russia, South Africa, Uruguay, Brazil, UAE	China	

UAE
Ethi-opia
Uzbeki-stan
Iran
Bangla-desh
China
Colom-bia
Algeria
China
Indo-nesia
India
Russia
Urug-uay
South Africa
Brazil

Maturity level definitions:

- Initial: short-term planning, fragmented R&D, low private funding, and limited VC/IPO activity.
- Basic/middle: emerging long-term visions, R&D spending between 0.7–1.5% of GDP, and growing domestic venture ecosystems.
- Advanced / best in class: strategic specialisation (≤5 domains), 20-year horizons, R&D >2% of GDP (with >50% private share), and robust financial markets for tech.

BRICS-NDB Countries Tech Synergy Map

Cluster	No.	Technology domain	China	India	Russia	Brazil	South Africa	Indo-nesia
Universal	1	Artificial intelligence	✓	✓	✓	✓	✓	✓
	4	Life sciences	✓	✓	✓	✓	✓	✓
Broad	7	Energy tech	✓	✓	✓	✓	✓	✓
	3	Distributed computing and DLT	✓	✓	✓	✓	✓	✓
	5	Agritech	✓	✓	✓	✓	✓	✓
Medium	2	Robotics and sensing	✓	✓	✓	✓		✓
	8	New materials	✓		✓	✓	✓	✓
	6	Space tech	✓	✓	✓	✓	✓	✓
Niche	10	New mobility	✓	✓	✓	✓		✓
	9	Quantum technologies	✓	✓	✓			

BRICS-NDB Countries Technology Domain Overlap Matrix

Technology domains

1. Artificial intelligence (AI)
2. Robotics and sensing
3. Distributed ledgers and computing
4. Life sciences
5. Agritech
6. Space tech
7. Energy tech
8. New materials
9. Quantum technologies
10. New mobility

	China	India	Russia	Brazil	South Africa
China		9	10	9	7
India	9		9	8	6
Russia	10	9		9	7
Brazil	9	8	9		7
South Africa	7	6	7	7	
Indonesia	9	8	9	9	7
UAE	8	7	8	8	6
Iran	10	9	10	9	7
Egypt	6	6	6	6	6
Ethiopia	5	5	5	5	5
Bangladesh	8	7	8	8	6
Colombia	7	6	7	6	6
Algeria	6	6	6	6	5
Uzbekistan	6	5	6	6	5
Uruguay	5	5	5	5	5

Overlap intensity (number of domains)

0 2 5 8 10

UAE	Iran	Egypt	Ethiopia	Bangla-desh	Colom-bia	Algeria	Uzbeki-stan	Uru-guay	Key findings
✓	✓	✓	✓	✓	✓	✓	✓	✓	**Universal (2 domains):** AI and life sciences are shared across all 15 countries—a foundation for multilateral BRICS+ projects. **Niche (2 domains):** quantum technologies (5 countries) and new mobility (8 countries)—potential for targeted bilateral collaboration.
✓	✓	✓	✓	✓	✓	✓	✓	✓	
	✓	✓	✓	✓	✓	✓	✓	✓	
✓	✓	✓		✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	✓	✓		✓	
✓	✓			✓		✓	✓		
✓	✓			✓	✓		✓		
✓	✓	✓	✓						
✓	✓			✓					
	✓				✓				

Indo-nesia	UAE	Iran	Egypt	Ethiopia	Bangla-desh	Colom-bia	Algeria	Uzbeki-stan	Uruguay
9	8	10	6	5	8	7	6	6	5
8	7	9	6	5	7	6	6	5	5
9	8	10	6	5	8	7	6	6	5
9	8	9	6	5	8	6	6	6	5
7	6	7	6	5	6	6	5	5	5
	8	9	6	5	8	6	6	6	5
8		8	5	4	7	5	5	5	4
9	8		6	5	8	7	6	6	5
6	5	6		5	5	5	5	4	5
5	4	5	5		4	4	4	3	4
8	7	8	5	4		6	6	6	5
6	5	7	5	4	6		5	5	5
6	5	6	5	4	6	5		5	5
6	5	6	4	3	6	5	5		4
5	4	5	5	4	5	5	5	4	

Based on the analysis conducted, we can break the member countries to four levels of technological development.

- **Level 1: advanced / global leader** (China): has a sufficiently developed full deep tech funnel and global IP leadership. Focuses on 6 core domains including quantum tech, brain-computer interfaces, and AI.
- **Level 2: basic/middle** (India, Russia, UAE): characterised by strong set of tools along the funnel but has a wide range of priorities.
- **Level 3: emerging** (Brazil, Iran, South Africa, Uzbekistan, Indonesia): has selected priority sectors (e.g. bioindustry in Brazil, UAVs in Iran, agritech in South Africa) but suffers from fragmented funding and developing regulatory frameworks.
- **Level 4: initial** (Egypt, Ethiopia, Bangladesh, Uruguay, Colombia, Algeria): primarily adoption-oriented, integrating foreign technology into local niches (e.g. fintech in Bangladesh, software export in Uruguay). They depend heavily on imported technology and basic grant systems.

Taken together, the analysis of the benchmarking results, country-level maturity levels, and priority domains shows that the BRICS NDB group does not face one uniform technology challenge. It faces a set of uneven national systems that require differentiated development logic driven by the individual development level along with the technology life cycle, selective coordination, and stronger mechanisms for converting scientific and entrepreneurial inputs into scalable products and firms.

4 Main Challenges, Gaps, and Institutional Barriers in BRICS NDB Countries

As was mentioned earlier, the BRICS NDB countries do not face a single isolated problem but a broad range of challenges that prevent them from realising their full potential. In many member states, priorities are too broad, support measures are not tied to measurable socio-economic outcomes, and the links between science, business demand, capital, and market exits remain weak. As shown earlier, this reduces the conversion of research into patents, start-ups, scale-ups, exits in financial markets, and, in certain instances, formation of national champions.

The BRICS-NDB group remains caught in a "middle-tier R&D trap" characterised by high engineering mass—a large workforce of capable engineers—but weak conversion into high-value intellectual property (IP) and global technical standards.

As mentioned earlier, most member countries have a massive consolidated market. Yet the countries capture a disproportionately small share of global high-tech value. With the exception of China, the group remains caught in a "middle-tier R&D trap"[28] characterised by high engineering mass—a large workforce of capable engineers—but weak conversion into high-value intellectual property (IP) and global technical standards. To understand the drivers of the current situation, we review the challenges along the technology development life cycle.

Strategic Governance & Priority Selection Challenges

Effective technological development is predicated upon prioritisation, necessitating a concentrated focus on a limited set of strategic domains within a sustained 20+ year horizon. Benchmarking of the BRICS NDB countries and global innovation leaders shows a number of strategic governance & priority selection challenges impending the development:

The state should orchestrate mission-critical frameworks and long-term strategic objectives, while the private sector and capital markets execute through smart money.

- **Unclear division of mandates of government and private sector:** the state orchestrates the mission-critical frameworks and long-term strategic objectives, while the private sector and capital markets execute through "smart money". This synergy ensures a seamless "idea-to-product" transition, often managed by seasoned technology entrepreneurs who bridge the gap between technical risk and commercial delivery.
- **Low R&D concentration:** while the group possesses an unparalleled reservoir of energy, capital, and STEM talent, it suffers from severe resource dispersion. Most BRICS nations attempt to maintain presence across 8–10 technological domains, leading to a dilution of intellectual capital. In contrast, global leaders and China have transitioned to a product-oriented phase, narrowing the focus to ≤5–6 domains. This concentration allows for the achievement of the critical mass necessary to overcome the patent quality gap and mirror the R&D structures of leaders like the USA and South Korea.

Deep tech demands a 20–25 year national strategic vision.

- **Short strategy horizons:** a critical inhibitor of deep tech within the bloc is the prevalence of short planning horizons. National innovation cycles are frequently tethered to tactical or political windows of 5–10 years which are insufficient for the development of fundamental breakthroughs. Deep tech demands a 20–25 year national strategic vision; without this temporal alignment, ventures remain perpetually trapped in early-stage development.

While global leaders have adopted "mission-oriented" models that prioritise solving specific societal and security challenges through technological products, many BRICS nations remain in a reactive capacity-building mode.

- **Suboptimal management paradigms:** there remains a profound disconnect between fundamental scientific research and the pragmatic exigencies of the private sector. While global leaders have adopted "mission-oriented" models that prioritise solving specific societal and security challenges through technological products, many BRICS nations remain in a reactive capacity-building mode. This focus on infrastructure and generalised research volume over-targeted product outcomes results in an ecosystem that generates scientific output but lacks the industrial "market pull" required to achieve national technological leadership.

Comparative Matrix of National Deep Tech Governance Models

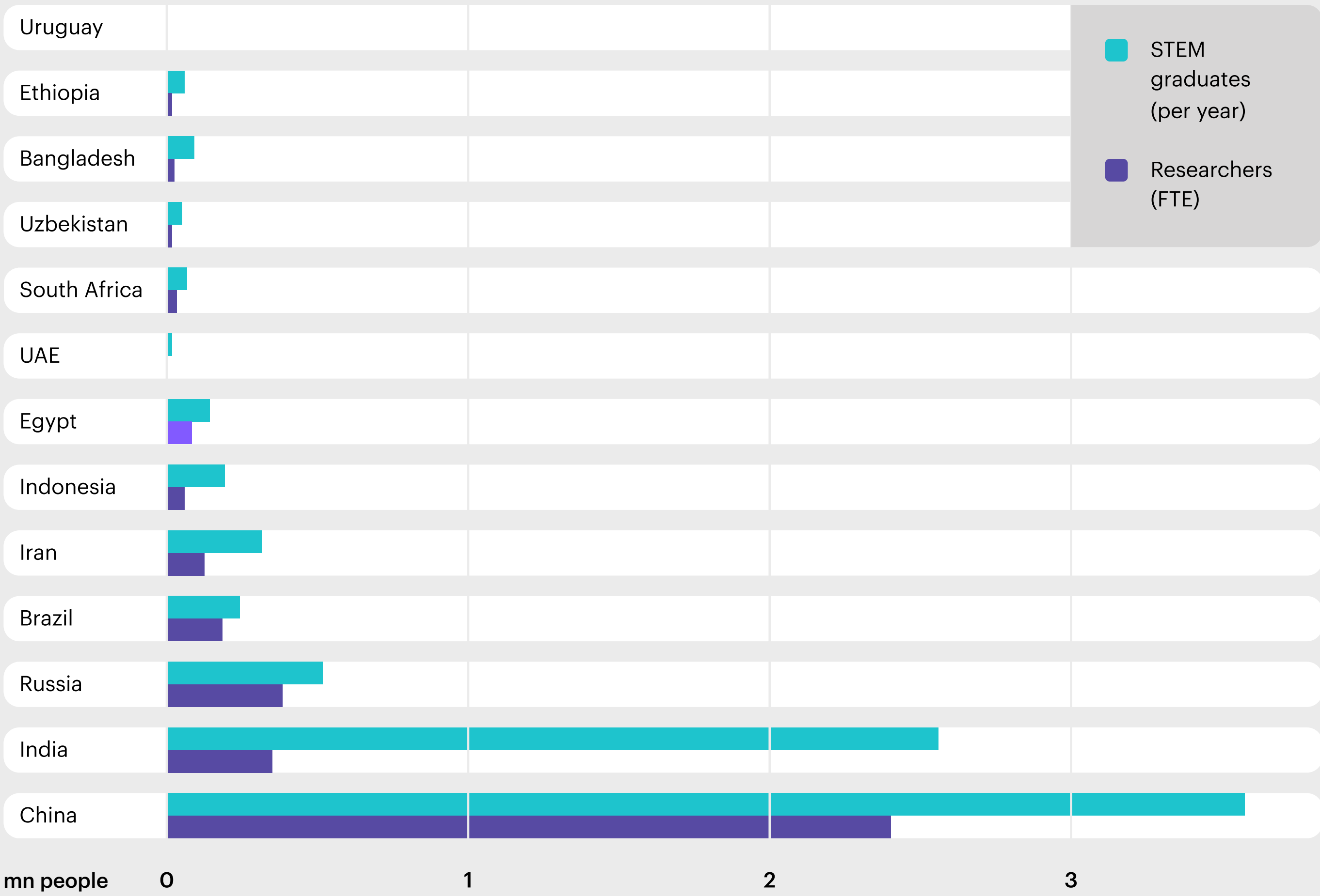
Levers	Global tech leaders	China	BRICS (excl. China)	New NDB shareholders
Division of mandates of government and private sector	**Market-public synergy:** state platforms, private smart money	**State-orchestrated scaling:** guidance funds, private tech-giants	**Fragmented coordination:** state-led capital, weak commercial bridge	**Emergent niches:** grant-based funding, foreign tech-transfer dependence
Concentrated R&D	**High:** 5 core and a few additional specific deep tech domains	**High:** strict focus on 6 deep tech domains	**Moderate/broad:** 8–10 domains (risk of dilution)	**Low:** fragmented sectors based on varying local needs
Long strategy horizon	**20–25 years** (e.g. US CHIPS Act, Israel IIA)	**25 years** (Vision 2049)	**5–10 years** (tactical/ political cycles)	**3–5 years** (project-based)
Optimal management paradigm	**Mission-oriented:** focused on solving specific societal or security challenges	**Product-oriented:** radical focus on industrializing 6 future sectors	**Capacity-building:** focusing on infrastructure and digital public goods	**Adoption-oriented:** integrating foreign tech into local niches (e.g. fintech)

R&D Performance Challenges

The R&D phase serves as the fundamental engine of deep tech. However, an analysis of global trends and the specific performance of emerging economies reveals that scientific volume does not necessarily translate directly into technological leadership. The primary differentiator between global leaders and developing cohorts is the efficiency of knowledge conversion into industrial assets.

In deep tech, the R&D phase is characterised by technical risk in addition to the market risk. While general tech relies on the application of existing tools, deep tech R&D aims to resolve fundamental scientific uncertainties.

R&D Talent Pipeline across BRICS-NDB countries



Many nations, particularly within the BRICS bloc, possess a massive "engineering mass"—producing approximately 8.5 million STEM graduates annually.

The middle-tier R&D trap: G7 and technology leaders maintain a researcher density nearly 5 times higher than the BRICS average.

A critical observation in modern R&D management is the "scale paradox"[29]. Many nations, particularly within the BRICS bloc, possess a massive "engineering mass"—producing approximately 8.5 million STEM graduates annually[30]. Please see the chart below for details. However, this volume often fails to produce high-value IP.

This is also accompanied by the following gaps:

- The "paper-driven" science gap: R&D is often measured by academic citations and publication volume rather than market-ready technologies.
- The middle-tier R&D trap: G7 and technology leaders maintain a researcher density nearly 5 times higher than the BRICS average (9.2 vs 1.8 per 1,000 employees)[31], leading to a higher concentration of specialised expertise.
- Commercialisation velocity: there is a lack of structured mechanisms for scouting promising technologies. The result is a linkage disconnect where research remains siloed from industrial application.

Venture Capital Market Challenges

Across the BRICS-NDB bloc (excluding China), deep tech ventures typically take 7–9 years to reach market — about 45% longer than the 4-5 year benchmark seen in Silicon Valley.

The countries' inability to provide a stable growth mechanism has precipitated a critical brain drain.

In the contemporary global economic landscape, deep tech has transcended its status as a mere category of high-tech start-ups, evolving into the foundational cornerstone of systemic technological development. However, the primary impediment to translating scientific breakthroughs into industrial-scale solutions remains the absence of a robust commercialisation mechanism. Within this framework, the venture capital market serves not merely as a source of liquidity but as a critical strategic bridge reconciling fundamental research with market exigencies. For the BRICS cohort and NDB shareholders, the failure to fortify this bridge has resulted in several acute systemic challenges:

- **Prolonged time to market (TTM) and the velocity gap:** a significant barrier to competitive parity is the suppressed velocity of the innovation cycle. The average time to market for deep tech ventures within the BRICS NDB bloc (excluding China) spans 7–9 years, representing a 45% decrease in commercialisation speed, compared to the 4–5 year Silicon Valley benchmark. As a result, by the time technologies mature, they are frequently superseded by faster-moving global incumbents.
- **Asymmetric talent migration and the founder retention crisis:** the countries' inability to provide a stable growth mechanism has precipitated a critical brain drain. The founder retention index[32] reveals a stark divergence in national capacity to anchor talent: while China maintains a high retention rate of 82% and the UAE has successfully positioned itself as a net importer of talent (92% index), other major economies suffer from severe attrition. Russia retains only 32% of its founders (with 68% relocating), and India retains 48% (with 52% relocating), effectively subsidising the innovation ecosystems of western hubs with their primary intellectual capital.
- **The unicorn deficit:** the cumulative efficacy of a venture market is best reflected in its ability to scale companies to unicorn status. Global technological leaders have accumulated over 1,200 unicorns, establishing self-sustaining growth mechanisms. In contrast, the BRICS group possesses approximately 420+, heavily concentrated in China and India. For the new NDB shareholders, the gap is even more pronounced, with an aggregate count of fewer than five unicorns, underscoring a systemic failure to nurture ventures from the seed stage to global market leadership.

Financial Market and Exit Challenges

The final stage of the technology development funnel—capital recycling through liquid exit events, which in some cases helps form national champions—remains the most significant structural bottleneck for the BRICS and NDB shareholder ecosystems. The inability to finalise and manage new technologies at this stage prevents the "re-injection" of capital and entrepreneurial expertise back into the domestic market, thereby stalling the transition to an autonomous innovation economy.

- **Systemic exit deficit and liquidity drain:** the absence of unified, high-depth technology exchanges within the bloc compels high-growth ventures to seek IPOs on western markets (e.g. NASDAQ). This reliance induces a liquidity drain, where exit proceeds and subsequent founder reinvestments remain within foreign systems, depriving the domestic ecosystem of the recycled capital for fueling the next innovation cycle.
- **Deficiencies in market depth and spin-off efficacy:** low market maturity is reflected in the marginal success rate of corporate spin-offs—under 5% in BRICS, compared to 15–20% in leading countries[33]. The gap highlights a lack of agility among national incumbents and a deficit in secondary market depth, leaving transformative technologies "trapped" within bureaucratic structures rather than scaling as autonomous national champions.
- **Low high-tech export concentration:** a critical structural challenge is the suppressed share of high-tech products within the aggregate export portfolios of most BRICS and NDB nations. While global leaders maintain high-tech export shares exceeding 25–30%[34], many members (excluding China) remain reliant on primary commodities or low-complexity manufacturing. This reliance on non-technological exports indicates a failure to integrate technologies into the global value chain, limiting the nation's ability to capture the complexity premium and reinforcing vulnerability to global price volatility.

The marginal success rate of corporate spin-offs—under 5% in BRICS, compared to 15–20% in leading countries.

To overcome these barriers, the bloc must transition to a mission-oriented model with at least a 20-year horizon. Success should be measured not by the number of papers published but by the ability to build an autonomous ecosystem that converts academic intelligence into global technical standards and industrial leadership.

While talent and infrastructure provide the necessary potential, the absence of specialised capital prevents the system from functioning as a cohesive unit. Without a fundamental recalibration of investment depth and instruments, the technological development funnel will remain fragmented, unable to bridge the gap between scientific capacity and industrial leadership; thus, financing remains the binding constraint. Financing serves as the primary overarching determinant of global technological development as it provides the essential resource required to transform theoretical scientific research into large-scale industrial applications, thereby ensuring the continuity of the innovation life cycle.

5 Financing as the Binding Constraint: Being Smart and Stage-Appropriate

As in most development initiatives, finance is a scarce resource. However, when it comes to technological development, across most member economies, the problem is not simply that there is “not enough financing”.
The more important constraint is that financing remains too fragmented and poorly matched to the technology life cycle. As the previous sections show, many member states still lack the depth of R&D funding, venture capital, and financial market exits needed to move technologies consistently from science to commercialisation and scale.

The core issue is not the lack of money, but the absence of a full financing stack.

The core issue is therefore not just lack of money but the absence of a full financing stack. Early-stage science requires patient public capital and research infrastructure; commercialisation requires seed and venture capital; later-stage scaling requires growth funding, project finance, and credible exit routes. In the countries where these layers are missing or weakly connected, the technology funnel breaks before ideas can become products, start-ups, large firms, and potentially national champions.

Within the BRICS and NDB shareholder countries context, the financial architecture currently functions as a “leaky funnel”, where a lack of specialised tools at each stage leads to value leakage and the “scale paradox”. The gaps are visible in the table below.

Deep Tech financing and market benchmarks: BRICS-NDB vs technology leaders

Group/ cohort	R&D expenditure (% of GDP)[35]	Private funding of R&D (%)[36]	VC market size (% of GDP)	Deep tech share of total VC (%)[37]	Financial market size (% of GDP)[38]	Tech market cap (% of GDP)[39]	High-tech exports (% of GDP)[40]
Tech leaders	3.5–6.4%	65–79%	0.5–1.2%	30–45%	200–350%	35–75%+	10–35%+
China	~2.7%	~77%	~0.45%	~28–33%	~120–160%	~25–35%	~18–25%
BRICS (excl. China)	0.6–1.6%	35–45%	~0.15–0.35%	~15–20%	~60–110%	~5–15%	~2–12%
New NDB shareholders	<0.8%	<20%	<0.10%	<10%	<60%	<5%	<5%

Based on the benchmarks and the best practices for technological development in countries around the world, we can determine the required levels of funding for each stage of the funnel to achieve technological leadership, including:

- R&D expenditures >2% of GDP;
- venture capital market size >1% of GDP;
- market capitalisation of public technology companies >25% of GDP.

Based on the combined GDP of the countries, the approximate investment growth potential amounts to $406.5 bn.

To bridge the structural “scale paradox” and support the deep tech development, the BRICS and NDB shareholders must address significant liquidity bottlenecks. The following table illustrates the additional investment potential to be realized to reach the specified minimum thresholds for technological leadership. Based on the combined GDP of the countries, the approximate investment growth potential amounts to $406.5 bn.

Estimated R&D and venture-capital additional investment potential to reach GDP Investment Thresholds for Technology Competitiveness

Performance metric	Cohort	Current level (USD)	Target level (% of GDP)	Additional investment potential (USD)	Growth factor required
R&D expenditure	China	$495.8B	Met	-	-
	BRICS (excl. China)	$92.8B	>2.0%	+$130.3B	x2.4
	NDB (new)	$3.7B	>2.0%	+$28.9B	x8.8
VC market volume	China	$43.6B	>1.0%	+$141.4B	x4.2
	BRICS (excl. China)	$21.2B	>1.0%	+$94.2B	x5.5
	NDB (new)	$0.8B	>1.0%	+$11.7B	x15.6
Total investment cap				+$406.5B	

Financing at the commercialisation stage is the primary bottleneck preventing scientific potential from scaling into industrial leadership.

For the non-China BRICS members, the growth potential is notably higher, requiring nearly doubling the investment.

→ **The binding constraint (VC market)**
While the R&D potential appears largest in absolute terms, the growth factor for the venture capital market among new NDB shareholders (times 15.6) is the most critical. This confirms that financing at the commercialisation stage is the primary bottleneck preventing scientific potential from scaling into industrial leadership.

→ **Structural heterogeneity**
For the non-China BRICS members, the growth potential is notably high and requires nearly doubling the investment.

→ **Capitalisation deficit**
The BRICS NDB countries have a much lower tech market capitalisation to GDP ratio, compared to benchmarks. Bridging this gap will require an increase of market capitalisation by approximately $1.4 tn. To achieve this, it is insufficient to simply increase funding. It is required to develop stock exchanges and regulatory frameworks that retain unicorns as national champions within the domestic ecosystem to prevent liquidity drain to western markets.

The main the main part of the potential should be realized by non-governmental funding sources, which means a change in the entire funding model will be necessary.

At the same time, the target structure of funding sources must change. Given current ratios, the target state should see the share of public funding decrease at all stages, while the share of private funding should increase. Therefore, the main the main part of the potential should be realized by non-governmental funding sources, which means a change in the entire funding model will be necessary. In the target model, the share of private capital should increase as a technology advances through the development funnel, achieving total dominance at the scaling stages.

Required shift in the public-private funding mix across the Deep Tech lifecycle

Development stage	Current ratio (gov/private)	Target ratio (gov/private)	Role of capital
R&D[41]	80% / 20%	40% / 60%	Transition to a market pull model
Commercialisation (VC)[42]	60% / 40%	20% / 80%	Dominance of smart money
Scaling (growth/PE)[43]	50% / 50%	5% / 95%	Deep private capital markets driven by institutional investors (incl. pension funds and insurers)

The task of realizing the identified potential independently is challenging for most nations.

Bridging the identified structural gaps and reconfiguring the financing framework for technological development would require a simultaneous mobilisation of financial and intellectual resources on a scale that currently exceeds the available resources of most national systems. The magnitude of the investment—exceeding $160 billion annually just to reach the 2% R&D-to-GDP threshold—renders the task of closing these gaps independently very challenging for most nations.

No single economy within the bloc (with the notable exception of China) possesses the simultaneous critical mass of venture capital, stock market depth, and comprehensive technological competencies across all ten deep tech domains. Attempting isolated development under conditions of "scale deficiency" inevitably leads to further fragmentation of resources, duplication of costs, and, ultimately, defeat in the global technological race.

A viable response requires a financing architecture aligned with the technology life cycle and organised across domestic and international levels.

Taken together, these imbalances are at best hard to be resolved through isolated national measures alone. A viable response requires a financing architecture aligned with the technology life cycle and organised across domestic and international levels.

6 Financing Model Across the Technology Development Funnel

The question then is not whether a financing architecture is needed, but how it should be designed. Given the financing potential outlined above, the task is to define a lifecycle-based architecture that can connect research, commercialisation, and scale across the BRICS and NDB shareholder group. Each stage carries a different risk profile, a different capital requirement, and a different mix of public and private instruments. This chapter, therefore, turns from the logic of financing as a binding constraint to the design of the financing model itself. The task here is not to restate why capital matters are important but to show how a stage-appropriate architecture can be organised across domestic and international tiers for a heterogeneous BRICS NDB system.

The suggested architecture is built around a premise that the toolkit spans the entire technology funnel, from research and validation to scaling and capital-market exits, and that most countries do not need to build each layer at sufficient depth on a stand-alone basis.

Lifecycle-based financing architecture across the technology development funnel

Dimension	Research and validation	Pilot and industrial scaling	Deployment and liquidity
Dominant risk source and the central question	Scientific and technical risk. The central question: can the technology work at all?	Commercialisation, validation, and scale-up risk. The central question: can the technology survive pilot deployment, first industrial application, and market entry?	Execution, expansion, and liquidity risks. The central question: can the technology be scaled, rolled out across markets, and generate exit opportunities?
Typical capital requirement[44]	Small per company, but high uncertainty and very low bankability. Startup-stage rounds below $15M	Capital needs rise sharply and become discontinuous. Breakout-stage rounds of $15–100M, often combined with concessional or blended structures	Large-scale capital becomes essential. Scaleup-stage rounds above $100M, often complemented by project finance, institutional capital, and public markets
Key instruments	Non-dilutive grants; basic infrastructure; shared labs and testing grounds; incubators; pre-seed equity	Seed funds; VC, pilot grants; blended finance; concessional debt; guarantees; fund-of-funds structures	Project finance; mezzanine and growth equity; strategic M&A; public equity markets; export credit and guarantees; institutional capital
Public- private financing mix	Public and non-dilutive capital dominate. Private capital is present mainly for team formation, proof of concept, and early validation	Mixed structure. Public capital de-risks the stage, while private capital becomes increasingly important for pilots, industrial validation, and first market applications	Private capital becomes dominant. Public instruments play mainly a catalytic, enabling, or strategic role rather than acting as the primary funding source
Typical providers	Government and development institutions;; business angels; incubators	State and quasi-state investors; venture funds; corporate investors; co-financing platforms; development banks	Private capital; strategic investors; capital markets; pension and insurance capital; export-credit institutions; national champions

While this model is relatively simple, it is highly uneven in institutional feasibility across the analysed group of countries. Most countries can support parts of the research and validation stage domestically through public funding, core infrastructure, and early-stage support mechanisms. Far fewer can sustain pilot and industrial scaling, which requires a deeper combination of risk-tolerant capital, industrial demand, and de-risking instruments. Deployment and liquidity are more demanding still as they depend on larger pools of long-term capital, broader market access, and more developed exit channels. In practice, the later stages of the funnel are materially harder to support at the national level alone.

Domestic and International Perimeters

The financing model must distinguish between domestic minimum capabilities and shared regional tools.

The financing model must distinguish between domestic minimum capabilities and shared regional tools. The model therefore cannot be organised as a uniform list of instruments applied in the same way across all countries. Some capabilities have to remain domestically anchored because they determine whether technologies enter the funnel at all; other tools can be pooled at the BRICS NDB level because they depend on market scale, late-stage liquidity, and cross-border aggregation. The table below summarises this split.

Domestic and international functions in the BRICS-NDB financing architecture

Life cycle stage	System function	Must remain domestically anchored	Can be pooled or shared at BRICS NDB level
Cross-cutting	Strategic priorities and governance	Long-term strategic vision; national governance model; alignment with domestic industrial structure	Cross-country coordination of specialisation and shared technology priorities
Research and validation	Research base and early-stage pipeline	R&D intensity; public research infrastructure; IP protection; early-stage grants and incubators; minimum national pre-seed/seed capability	Technology mapping; access to complementary research assets; selected shared "megascience" platforms
Pilot and industrial scaling	Commercialisation, pilot deployment, and demand formation	Local development institutions; corporate off-takes; pilot demand; founder support	Cross-border venture liquidity; shared investor access; regional commercialisation networks
	Late-stage venture, scale-up, and growth finance	Selective domestic participation where markets are large enough	Multilateral fund-of-funds structures; co-investment platforms; later-stage VC and growth capital
Deployment and liquidity	Exit and liquidity infrastructure	Domestic exchanges and strategic-sale routes where viable	Shared liquidity platforms; common or linked stock-exchange solutions; pooled capital-market depth
	Internationalisation, export support, and market access	National export support and regulatory preparation	Export credit, guarantees, technology-transfer mechanisms, and wider market-access arrangements

R&D capacity, early-stage commercialisation tools, and a minimum national venture layer cannot be entirely outsourced.

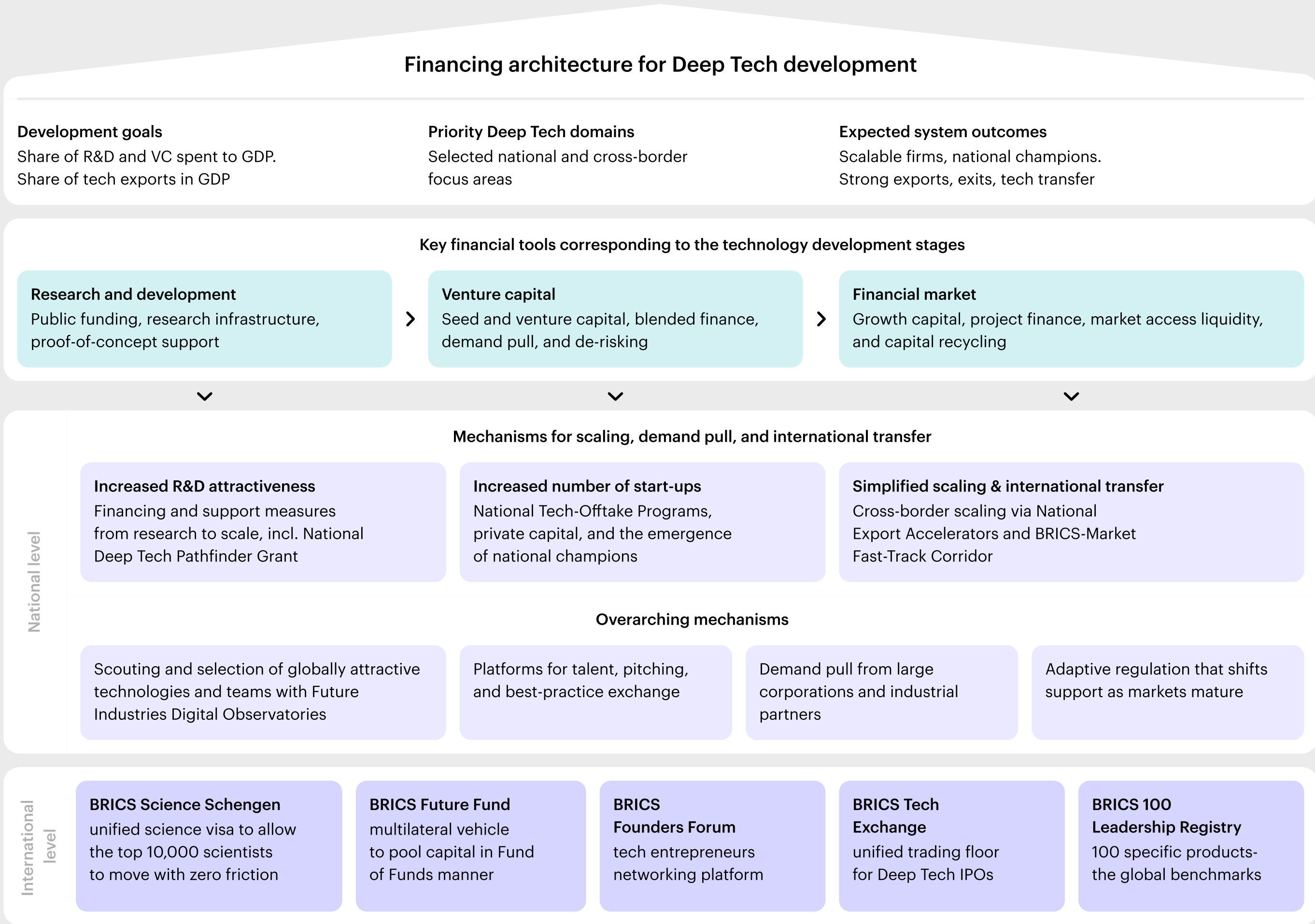
At the international level, BRICS and the NDB shareholder group need a financing architecture that allows participants to submit, screen, and fund cross-border investment transactions in a secure and transparent manner.

In practical terms, this means that R&D capacity, early-stage commercialisation tools, and a minimum national venture layer cannot be entirely outsourced. By contrast, later-stage liquidity, multilateral venture depth, export finance, and parts of the exit infrastructure become more efficient when they are pooled across countries rather than duplicated in thin national markets.

At the international level, BRICS and the NDB shareholder group need a financing architecture that allows participants to submit, screen, and fund cross-border investment transactions in a secure and transparent manner. On the demand side, there are projects seeking capital and investors seeking allocation opportunities. On the intermediation side, there are local development institutions—for example, development banks or funds of funds—together with private investors that help structure and advance transactions.

The architecture, therefore, operates through a two-tier architecture. The national tier performs origination, local screening, and domestic orchestration; the international tier performs aggregation, qualification, co-investment, and access to larger pools of capital.

- **1st tier: national;** it will comprise local development institutions. This tier will source local investors seeking to allocate their capital and potential projects—both will be assessed against the centrally established criteria of investor and project qualification framework.
- **2nd tier: international;** it is made up of the international institutions for technology development. This tier will act as the coordination center, aggregating the projects into a single pool. The institutions will be tasked with devising qualification criteria and ultimately "green-flagging" the incoming projects that get passed from the first tier. This tier will also interact with large-scale or international organisations such as the Sovereign wealth fund (SWF) and MDBs.



Summary architecture of development goals, priority domains, and national/international institutional support

A more realistic model is a clustered one, in which countries participate through different roles depending on the scale, maturity, and structure of their technology systems.

A shared financing architecture does not imply a single undifferentiated market. The more realistic model is a clustered one, in which countries participate through different roles depending on the scale, maturity, and structure of their technology systems.

- **Large-system anchors:** countries like China, India, Russia, and Brazil combine broader industrial bases, deeper research systems, or larger domestic markets. Their role is to anchor heavier layers of the stack, especially where concentration of capital and demand is required.
- **Venture accelerators and market-scale hubs:** the UAE and Indonesia illustrate a second role. The UAE provides liquidity and investor access, while Indonesia provides large-scale market pull. These systems do not replicate the full R&D depth of the largest technology powers, but they are critical for scaling and regional absorption.
- **Targeted-development and niche-specialisation systems:** countries like Algeria, Ethiopia, and Egypt align universal deep tech domains with one or two highly relevant domestic sectors. The Latin American cluster—especially Brazil, Colombia, and Uruguay—also shows a more regionally coherent emphasis on agritech and adjacent domains.

The cluster model avoids the unrealistic assumption that every country must replicate the full deep tech stack on a national basis. It allows minimum domestic capabilities to be preserved, while later-stage scale, liquidity, and market access are organised through pooled arrangements.

The dual-tier model and the role of national champions, therefore, connect the financial side of the architecture with the demand side.

The dual-tier model and the role of national champions, therefore, connect the financial side of the architecture with the demand side. Without that connection, even well-designed funding instruments remain isolated pools of capital rather than a functioning technology-development system.

National Level Architecture

At the national level within the BRICS NDB countries, these mechanisms function as a unified, vertically integrated system designed to transition technology from initial concept to global market dominance.

Government-led development institutions should not crowd out private capital.

Government-led development institutions should not crowd out private capital. Their role is to create investment "lifts", close value-chain gaps, and build the conditions under which private investors can participate earlier, at a lower risk, and on a greater scale.

National development institutes deploy a sequence of financial instruments—from R&D grants for early-stage prototypes to subsidised loans and equity injections for full-scale commercialisation.

The increased R&D attractiveness mechanism operates through a technology-readiness-aligned financing corridor that provides seamless support as firms advance from experimental research to industrial scale. National development institutes deploy a sequence of financial instruments—from R&D grants for early-stage prototypes to subsidised loans and equity injections for full-scale commercialisation. A concrete example is the **National deep tech Pathfinder grant**: a tiered funding program providing non-dilutive grants for early-stage projects, which automatically converts into equity-matching scale-up funds once the technology reaches maturity, de-risking the transition for private venture capital.

National champions have to be not merely an output but a core instrument of system design.

Governments should implement national tech-offtake programmes.

To increase the number of start-ups in this architecture, national champions have to be not merely an output but a core instrument of system design. The "corporate to champion"" mandate integrates large-scale industrial players and state-owned enterprises as primary "anchor customers". By linking start-ups to these giants, the system ensures that innovation is absorbed, scaled, and carried to global markets. To realise this, governments should implement **national tech-offtake programs**: a national registry where state corporations publish future needs challenges. Start-ups that solve these challenges receive guaranteed five-year procurement contracts (offtake agreements).

There should be a mechanism driven by national export accelerators that serves as the bridge between domestic success and global market penetration.

For **simplified scaling & international transfer** there should be a mechanism driven by **national export accelerators** that serve as the bridge between domestic success and global market penetration. These entities provide tech-focused companies with sovereign export guarantees and localised regulatory navigation, specifically utilising the BRICS NDB network to lower entry barriers. A key instrument is the **BRICS market fast-track corridor**: a reciprocal certification program where technology approved by one national regulator receives accelerated equivalence status in others, utilising the export credit agency (ECA) model to cover political and commercial risks of cross-border deployment.

Scouting and selection of globally attractive technologies and teams should be conducted through intelligence platforms such as the Future Industries Digital Observatories.

The framework is underpinned by **scouting and selection of globally attractive technologies and teams** through intelligence platforms such as **the Future Industries Digital Observatories** that proactively identify high-potential founding teams early in their development. This systematic scouting ensures that strategic resources are concentrated on the most promising intellectual property.

These are complemented by **platforms for talent, pitching, and best-practice exchange**s that function as dynamic knowledge hubs to facilitate the flow of expertise through structured pitching and founder-to-founder exchange. These platforms create the networking gravity needed to cross-pollinate expertise across the entire BRICS NDB ecosystem.

By fostering a direct link between tech-providers and industrial giants, the **demand pull from large corporations and industrial partners** ensures that private capital and corporate resources act as an accelerator. It creates a "pull" effect where industrial partners provide the real-world validation and initial scale required for deep tech products to reach global standards.

The system relies on adaptive regulation that shifts support as markets mature through dynamic Sandbox frameworks that allow legal environments to evolve in tandem with technological maturity.

Finally, the system relies on **adaptive regulation that shifts support as markets mature** through dynamic Sandbox frameworks that allow legal environments to evolve in tandem with technological maturity. Rather than applying rigid, static rules, national regulators shift support and compliance requirements as a technology moves from the lab to the mass market, ensuring regulation serves as a competitive advantage for the alliance.

International Level Architecture: expanding role of MDBs

At the international level, BRICS NDB countries need to create a layer of financial instruments and non-financial mechanisms to stimulate technological development, with the involvement of MDBs. To achieve these goals, we propose the following set of key mechanisms to ensure technological development at all stages of the deep tech funnel.

The BRICS 100 leadership registry should be formed by identifying 100 high-potential technologies.

The **BRICS 100 leadership registry** should be formed by identifying 100 high-potential technologies through a rigorous selection process, prioritising scalability and market-dominating potential. Once established, the mechanism will function as a specialised acceleration corridor, pooling the alliance's capital, R&D resources, and regulatory support to ensure these products achieve global benchmark status by 2035. By concentrating resources on this registry, the alliance will transform academic innovation into tangible industrial leadership that dictates future international standards.

The **BRICS science Schengen** should operate as a unified, frictionless mobility framework that grants 10,000 pre-vetted scientists a multi-country science visa for unrestricted travel and residency across the alliance. This mechanism functions through a shared digital credentialing platform where member states harmonise their immigration protocols and security clearances specifically for top-tier researchers. By removing bureaucratic hurdles, the system enables the seamless cross-border flow of talent, allowing experts to lead joint R&D projects and deploy their expertise instantly wherever the alliance's strategic innovation needs are the greatest.

The BRICS Future fund would functions as a strategic "fund of funds" designed to catalyse a high-impact pull model, bridging the gap between megascience projects and market-ready global products.

The **BRICS Future fund** functions as a strategic "fund of funds" designed to catalyse a high-impact pull model, bridging the gap between megascience projects and market-ready global products. By deploying a flexible co-investment architecture, it blends capital from Multilateral development banks (MDBs), national development institutes, and private investors into tailored tranches across all venture stages. This mechanism operates by de-risking deep-tech investments through blended finance, ensuring that breakthrough scientific R&D receives the sustained funding necessary to scale into dominant technological benchmarks for the global market.

The **BRICS Founders forum** serves as a high-level networking ecosystem designed to bridge the experience gap within the alliance by fostering structured mentorship and cross-border co-founding. Operating on a peer-to-peer model, the platform enables veteran tech leaders to exchange battle-tested insights and launch new ventures in partnership with emerging entrepreneurs, effectively scaling regional success into global dominance. The mechanism culminates in an annual Web Summit-level flagship event that serves as the ultimate gravity well for talent where deal-making, knowledge transfer, and strategic alliances are formalised to build the next generation of BRICS unicorns.

The BRICS tech exchange should operate as a unified framework that establishes specialised high-tech listing segments across existing major stock exchanges in BRICS financial hubs.

The **BRICS tech exchange** should operate as a unified framework that establishes specialised high-tech listing segments across existing major stock exchanges in BRICS financial hubs. Rather than creating a new entity, this mechanism harmonises listing requirements and cross-border trading protocols, allowing tech companies to tap into a consolidated pool of regional liquidity through their local bourses. By synchronising disclosure standards and investor protection rules, the exchange creates a "virtual single market" for technology stocks, making it easier for institutional investors to fund the alliance's most promising innovators while maintaining the stability of established national financial infrastructures.

7 Expected Effects and Management Implications

The end-to-end improvement of the deep tech investment approach in BRICS and NDB shareholder countries may generate significant impact. By addressing the binding constraints of financing and implementing relevant tools at each stage of the technology life cycle, the member countries can transition from technological fragmentation to global industrial leadership. The primary mechanism is the market-pull architecture, replacing siloed, supply-side R&D. It will have a distinct impact on each of the technology life cycle stages:

- It will increase the R&D attractiveness, lowering the risks by providing multilateral guarantees. This will lower or even prevent liquidity drain and IP migration to G7 hubs.
- It will stimulate the VC growth by cycle velocity optimisation reducing the average time to market (TTM) from the current 7–9 years to the global benchmark of 4–5 years.
- It will simplify scaling and improve access to markets, including financial markets, to achieve the critical mass necessary for deep tech commercialisation and IPOs.

Increasing investments by countries to 2% of GDP or higher will yield an impact of up to 5.6% of the bloc's combined GDP in 10–15 years.

At the national level, the proposed model should strengthen technological sovereignty, reduce duplication of R&D, raise GDP and employment through stronger high-tech sectors, and improve countries' ability to shape global standards. At the company level, it should expand access to a market of more than 3 billion consumers, patient capital, and a more transparent operating environment. Increasing investments by countries to 2% of GDP or higher will yield an impact of up to 5.6% of the bloc's combined GDP in 10–15 years, which, even in 2025 prices, would be near USD 1,751 bn per year. Reaching this level will require increasing R&D spending by 0.5% of the countries' combined GDP.

The VC funding increased by $247.3B (or 0,79% GDP) will yield more than $989B impact per year.

Development of the second stage of the technology life cycle will require increasing the venture capital market to 1% of GDP by all countries, which will require increasing market funding by 4.8 times compared to the current level. It will ensure 3.2 times increase in the number of tech start-ups in the 5–10 years horizon and 11.2 times increase in the number of deep tech start-ups; the number of unicorn companies will increase by at least 10 times, and the number of tech company IPOs will reach several hundred per annum. The VC funding increased by $247.3B (or 0,79% GDP) will yield more than $989B impact per year.

The total potential for R&D and venture capital investment in BRICS countries amounts to approximately $406B per year, representing a 1.6-fold increase compared to current levels.

At least 65% or $264B should come from private sources capital, not from government.

The co-operation effect is equally important. Cross-BRICS synergies can include, for example, AI combined with data-center capacity or complementary industrial capabilities. Cross-border deals, common platforms, and founder communities can then reduce language and market-access barriers that currently fragment the BRICS innovation space. The additional market potential for investment in R&D and VC in BRICS NDB counties is approximately $406B per year or 1.6 times higher compared to current levels. This requires harmonising regulations based on global best practices and mobilising the necessary resources, primarily from the private sector and foreign investors. It is important to note that of the estimated $406B, at least 65% or $264B should come from private sources capital, not from government.

The impact will strongly depend on the degree of international co-operation. While there are multiple possible scenarios, we would like to point out 2 extreme cases: an optimistic scenario that assumes a high degree of collaboration between the member states and a stagnation scenario that assumes persistent local silos where each country tries to implement the measures alone. The optimistic scenario will yield the numbers described above. The stagnation scenario results in weaker private investment, lower commercialisation efficiency, and a significantly smaller overall effect.

Estimated economic impact under integrated and fragmented strategy scenarios

Scenario	Impact mechanisms	Annual investment / target	Multiplier / growth factor	Estimated GDP addition	Contribution to total growth
Optimistic scenario	Direct R&D investment	$159.2B (multilateral)	1 : 11 multiplier [45]	$1,751B	5.59%
	Private VC mobilization	$247.3B (smart money)	1 : 4 (economic GVA) [46]	$989.2B	3.17%
	Total cumulative effect			$2,740.2B	8.76%
Stagnation scenario	Direct R&D investment	$159.2B (government-led)	1 : 2.1 multiplier [47]	$334,5B	1.07%
	Private VC mobilization	$247.3B (government-led)	1 : 1.3 (economic GVA) [48]	$321.5B	1.03%
	Total cumulative effect			$656B	2.1%

Below is the translated strategic roadmap, including targets for R&D (2.0%) and venture capital (1.0%) along with the projected economic impact under two diverging governance scenarios.

Country-level financing gaps and estimated GDP impact under alternative scenarios

Country	Est. GDP ($B)	R&D potential ($B)	VC potential ($B)	Optimistic scenario (GDP impact, $B)	Stagnation scenario (GDP impact, $B)
China	18,500	Target met	141.4	565.5	183.8
India	3,900	53.0	24.3	680.0	143.0
Russia	2,000	21.2	19.8	312.6	70.3
Brazil	2,300	18.9	20.0	284.8	65.0
South Africa	400	5.5	3.5	74.8	16.2
Indonesia	1,500	26.0	14.3	341.2	72.8
UAE	500	2.7	3.6	41.9	9.9
Egypt	380	3.8	3.2	53.8	12.0
Colombia	380	6.5	3.3	84.2	17.8
Bangladesh	450	7.7	4.4	103.1	22.0
Iran	400	4.8	3.9	68.9	15.3
Algeria	240	3.7	2.4	50.8	11.0
Uruguay	80	1.2	0.7	18.8	4.0
Uzbekistan	100	1.9	0.9	24.2	5.1
Ethiopia	160	2.3	1.6	36.7	7.9
Total	31,290	$159.2B	$247.3B	$2,741.9B	$656.1B

The disparity between the two scenarios highlights the critical role of co-operation and “smart money” governance.

The disparity between the two scenarios highlights the critical role of co-operation and “smart money” governance. The total economic benefit generated by closing the investment gaps is nearly 4.2 times higher under an integrated, market-led model than under a fragmented, state-led one.

It is important to point out that the structure of GDP may undergo significant change with a share of high-tech exports growing from 12% to 28% of GDP in the optimistic scenario.

In addition, we may expect the substantial growth of the stock market of up to $1,440B in the optimistic scenario. This impact, however, is hard to split by countries as it will depend strongly on the stock exchanges that will be used for IPOs of late-stage firms.

8 Conclusion

Across most member states, the size still fails to translate into strong IP or sizeable deep tech firms.

BRICS NDB group has scale on its side, accounting for more than 50% of the world's population, around 42% of global GDP at PPP. Yet scale has not converted into technological depth. Across most member states, the size still fails to translate into strong IP or sizeable deep tech firms. The question of why assets of this magnitude still produce weaker technological outcomes than they should is critical.

The problem is visible not only in lower inputs but in what those inputs produce.

The explanation runs through the full technology to development funnel. Underperformance is not concentrated at a single stage. It builds from one stage to the next and compounds over time. In most member states, R&D intensity remains in a low 0.2–1.5% of GDP range, compared to 3.2–6.4% in the leading technology economies. The venture capital market shows the same pattern: it is below 0.1–0.3% of GDP in most member states, compared with a benchmark of 0.6–1.1%. The problem is visible not only in lower inputs but in what those inputs produce. Leaders reach a patent quality index of roughly 65%, compared with about 30% in China and only 15–20% across the broader BRICS group. Even in the markets where capital market activity looks stronger, the picture remains highly uneven: in 2025, around 90% of BRICS technology IPO activity and funds raised came from China and India.

The weakness lies not only in volume but in sequence.

In this context, financing becomes decisive. What matters is not just the amount of capital available, but whether financing is present in the right form, at the right point in the life cycle, and with enough depth to carry technologies from research to commercialisation and then to scale. Public funding and basic infrastructure can often support the early research base. The harder challenge comes later, when technologies need risk-tolerant venture capital, pilot demand, project finance, and liquid financial markets for successful exits. According to our estimates, the immediate R&D and venture financing potential is about $406.5 bn, with a much larger capitalisation shortfall beyond that. More telling still is the structure of the gap. For the new NDB shareholders, the venture capital growth factor required to reach the threshold stands at ×15.6, well above the multipliers needed elsewhere. The weakness, in other words, lies not only in volume but in sequence.

This has direct institutional consequences. Most countries in the group will not be able to build a full deep tech stack on a stand-alone basis. That is not because national effort does not matter. However, later-stage scale requires resources that national systems rarely have on their own: deep venture markets, credible exit mechanisms, long-duration capital, and broad market access. Minimum domestic capabilities still have to exist where technologies enter the funnel—priority-setting, research infrastructure, early commercialisation, and local co-ordination. But later-stage functions such as liquidity, cross-border aggregation, market access, export support, and parts of the exit architecture are more efficient when pooled. Heterogeneity matters here. China, India, Brazil, Russia, the UAE, Indonesia, and smaller economies are in different positions and should not be pushed into a single institutional design.

Public capital should not permanently compensate for weak markets; it should make it easier for private capital to enter earlier, with lower risk and greater depth.

The financing question is inseparable from demand. Even a well-built capital stack will underperform if technologies are not tied to industrial adoption, anchor customers and clear routes to market. That is the economic role of national champions. Their function is to absorb innovation, support commercialisation, and reduce the loss of value between prototype and scale. The same logic applies to the funding mix. Of the additional $406.5B in annual R&D and venture mobilisation considered in the paper, at least 65%—roughly $264B—would need to come from private rather than public sources. Public capital should not permanently compensate for weak markets; it should make it easier for private capital to enter earlier, with lower risk and greater depth.

The BRICS NDB countries face a strategic choice on the degree of co-operation. The difference between an integrated, market-led model and a fragmented, state-led one is large enough to change the trajectory of the group. In the optimistic, integrated case, the estimated annual effect reaches about $2,742B, which is roughly 4.2 times bigger compared with $656B under stagnation. In the optimistic scenario, high-tech exports rise from 12% to 28% of GDP, while stock-market value could increase by as much as $1,440B. These figures are not automatic outcomes. They depend on execution. But they are enough to clarify the stakes. For a group of this scale, the issue is no longer whether technological ambition exists. The issue is whether the financing system can carry that ambition all the way—from research to scale and from scale to durable economic power.

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Knowledge Is Power Once Again. Building Financial Launchpad for Frontier Technologies for BRICS

Project Team

- Director of the Center for Business Education and Analytics, Central University Ilya Ivaninsky
- Deputy director of the Center for Business Education and Analytics, Central University Sergey Panfilov
- Project director Aleksandr Raksha
- Publisher Pavel Slakaev
- Editor-in-chief Olga Arkhipova
- Managing editor Maria Gribova
- Proofreader Valeria Pristupa
- Art director Danila Shorokh
- Team lead of design Ekaterina Shcheglova
- Designers Che E Ren, Aleksandra Korbankova

Contacts

- To contact the authors, request comments, or clarify usage rights, please send an inquiry to: **E-mail:** media@cu.ru
- For more research and analytics, visit our website: **Web:** cu.ru

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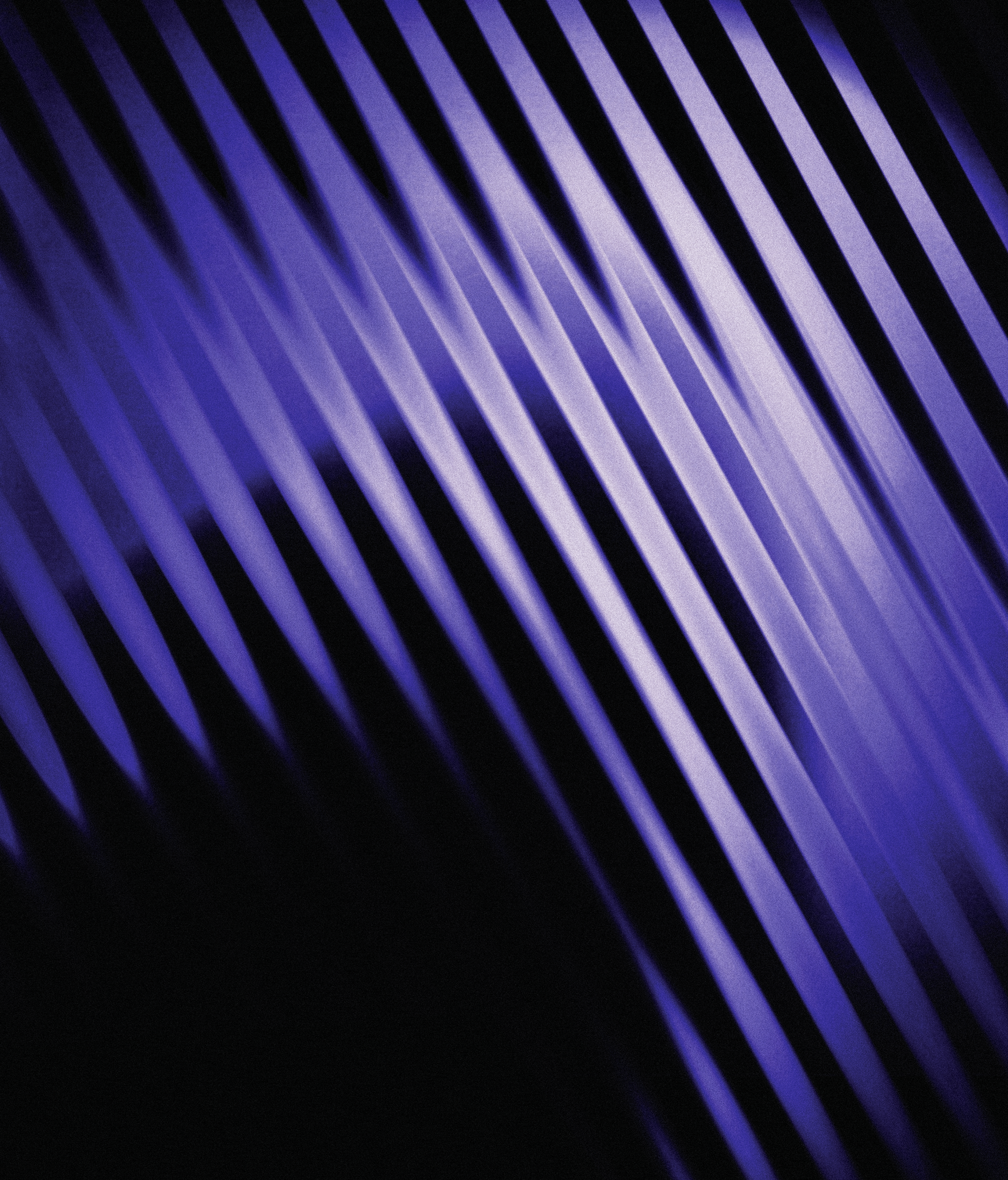

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